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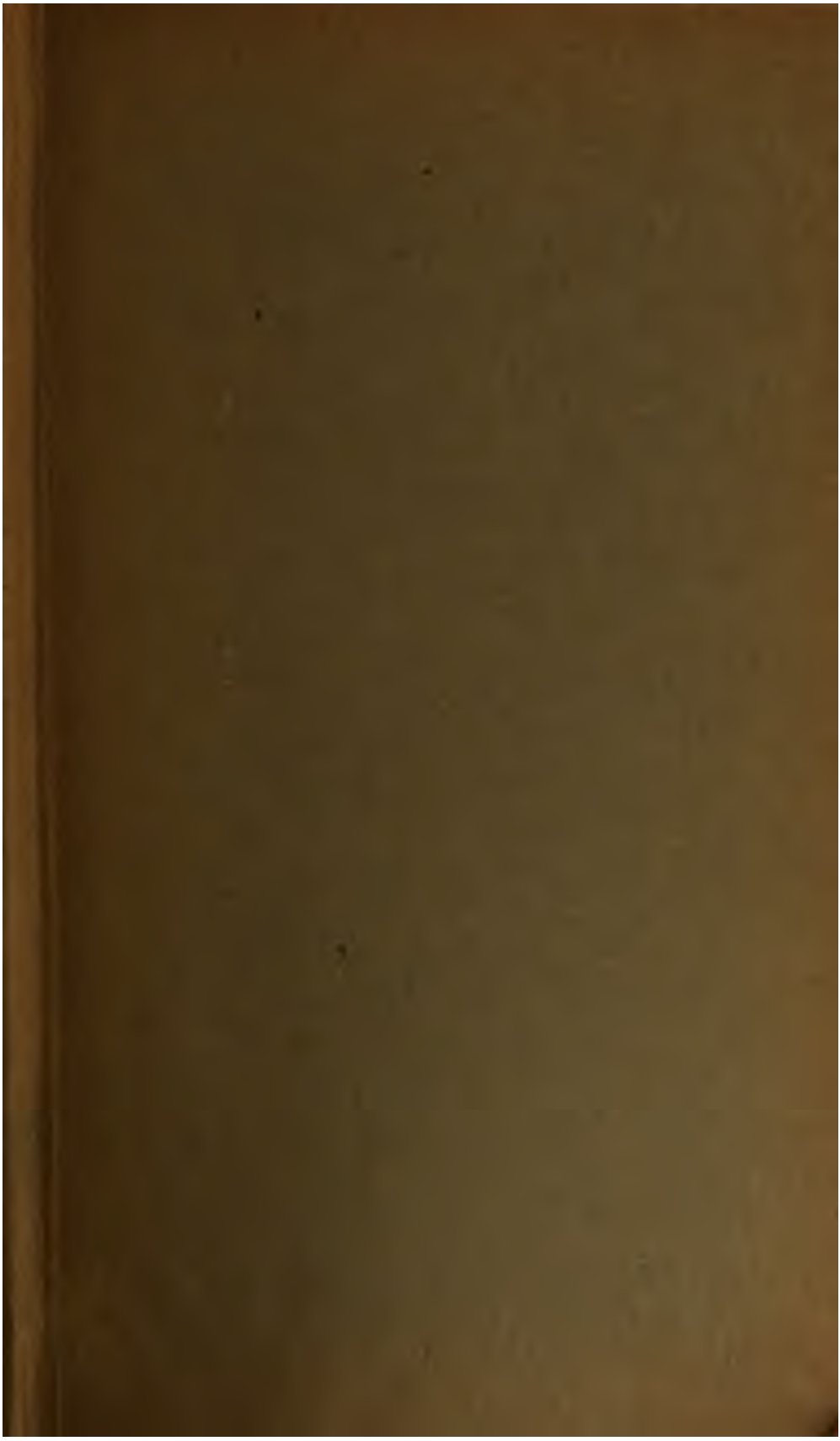

Water-Supply and Irrigation Paper No. 129 Series P, Hydrographic Progress Reports, 34

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL
BY
R. E. HORTON, E. JOHNSON, Jr., and JOHN C. HOYT

PART VI.—Great Lakes and St. Lawrence River Drainage

WASHINGTON
GOVERNMENT PRINTING OFFICE
1905

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., May 13, 1905.

SIR: I transmit herewith the manuscript of Part VI of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The original data for this paper were collected under the direction of District Hydrographers R. E. Horton and E. Johnson, jr. Mr. Horton had charge of the work in New York and southern Michigan, and was assisted by C. C. Covert. Mr. Johnson had charge of the work in the other States, and was assisted by F. W. Hanna. The assembling of the data and the preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, A. H. Horton, H. D. Comstock, F. H. Tillinghast, and R. M. Packard.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART VI.

By R. E. HORTON, E. JOHNSON, Jr., and JOHN C. HOYT.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	20,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

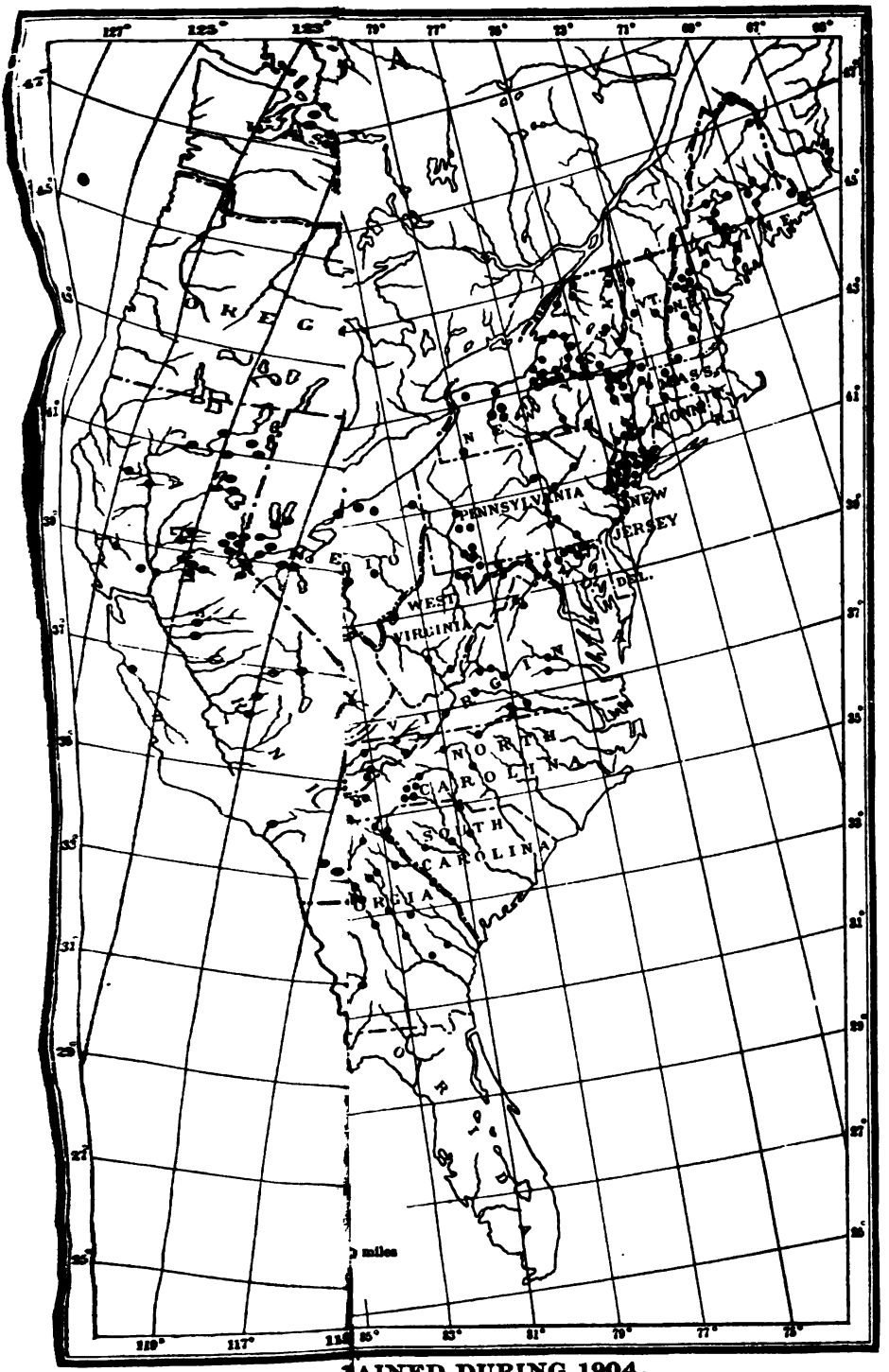
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage readings. From these two factors it is possible to estimate both the total flow and its distribution through the period of observations.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes, to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations; and second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station, with car, tag-line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tagged line indicating the points of measurement. Where the current is swift some



AINED DURING 1904.

appliance—generally a secondary cable—is necessary to hold the meter in position below the surface.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. Great care is taken in the selection and equipment of gaging stations, in order that the data may have the required degree of accuracy.

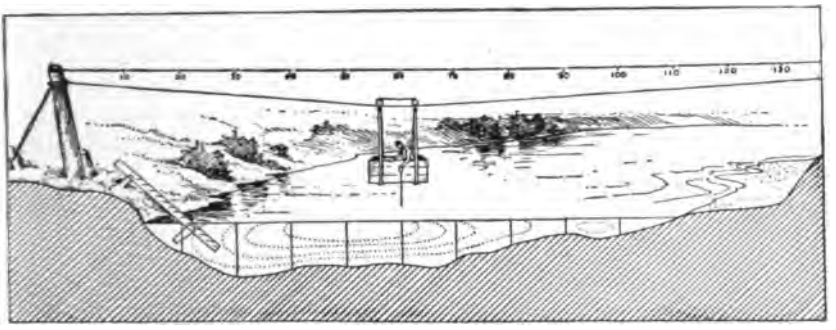


FIG. 1.—Cable station, showing section of river, car, gage, etc.

On many of the larger rivers where water power is developed by dams, estimates of flow are obtained by observing the head on the crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points are usually at regular intervals, varying from 2 to 20 feet, depending

upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and soundings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth, for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between 0.94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from 0.85 to 0.95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity-curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity-curve and the initial line. Owing to the length of time it takes to make these measurements, they are seldom used except for determining coefficients for purposes of comparison, and for measurements under ice.

PRICE CURRENT METERS, WITH BUZZERS.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity twice the mid-depth velocity, and the bottom velocity by 4.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface.. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights (2 and 3 depend on 1).

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds, the results of the discharge measurements are platted on cross-section paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared. The mean velocity and area determined for each discharge measurement are also platted. Through these points the curves of mean velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at vari-

ous stages as determined by these curves. These curves of mean velocity and area are of special value in determining the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station rating curve, the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character, the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made, the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes occur.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are taken either by integration in verticals or by vertical velocity-curves, as sufficient experiments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part VI, is published in a series of twelve Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainages.

Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.

Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.

Part 5. Eastern Mississippi River drainage.

Part 6. Great Lakes and St. Lawrence River drainage.

Part 7. Hudson Bay, Minnesota, Wapsipincon, Iowa, Des Moines, and Missouri River drainages.

Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.

Part 9. Western Gulf of Mexico drainage.

Part 10. Colorado River and the Great Basin drainage.

Part 11. The Great Basin and Pacific Ocean drainage in California.

Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations, and such other information that has been collected that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest,

and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns, which are defined on page 12, are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following

Survey publications. A detailed index of these reports (from 1888–1903) is given in Water-Supply Paper No. 119:

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

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The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Michigan (*Southern Peninsula*).—District hydrographer, R. E. Horton.[a] Records have been furnished by the following individuals and corporations: Kalamazoo Valley Electric Company, Kalamazoo, Mich.; Charles A. Chapin Electric Company,

[a] Office of district hydrographer for Michigan (Southern Peninsula) and New York, 75 Arcade, Utica, N. Y.

Buchanan, Mich.; Newaygo Portland Cement Company, Newaygo, Mich.; Fletcher Paper Company, Alpena, Mich.; George S. Pierson, Kalamazoo, Mich.; L. W. Anderson, city engineer, Grand Rapids, Mich.; Traverse City, Mich.; citizens of Sherman, Mich. Transportation has been furnished by the Au Sable and Northwestern Railroad Company. In the maintenance of gaging stations on Huron River a large part of the expense has been borne by the Washtenau Electric Company, Ann Arbor, Mich. Acknowledgment is also due to Lyman E. Cooley, Chicago, Ill., and R. W. Hemphill, in connection with gagings on Huron River.

Michigan (Northern Peninsula).—District hydrographer, E. Johnson, jr.[a] Acknowledgment is due W. J. Phillips for voluntary observations furnished at Iron River.

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LAKE MICHIGAN DRAINAGE BASIN.

The Lake Michigan drainage basin comprises a comparatively narrow strip of flat or gently rolling land in eastern Wisconsin, on the west shore of the lake, and a much wider strip of nearly the same character in Michigan on the east shore of the lake. The principal streams entering the lake from the west are the Fox and Menominee rivers; from the east, the St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The following pages give the results of data collected during 1904 in the Lake Michigan drainage basin.

ESCANABA RIVER NEAR ESCANABA, MICH.

Escanaba River rises near Champion, southwest of Lake Superior, in Upper Peninsula, Michigan, and flows southeasterly a distance of 70 miles, entering Lake Michigan through Little Bay de Noquette.

[a] Office of district hydrographer for Michigan (Northern Peninsula) and Ohio, 876 Federal Building, Chicago, Ill.

[b] Office of district hydrographer for Michigan (Southern Peninsula) and New York, 75 Arcade, Utica, N. Y.

[c] Office of district hydrographer for Vermont, 6 Beacon street, Boston, Mass., rooms 808–809.

The gaging station is located 4 miles above the mouth of the river at a single-span highway bridge, where a chain gage was established in June, 1903. Bench mark No. 1 is the top surface of the steel abutment at the right end of the bridge on the downstream side. Its elevation above gage datum is 15.15 feet. Bench mark No. 2 is a nail in the root of a 5-inch birch tree about 200 feet east of the east abutment and about 50 feet downstream. Its elevation above gage datum is 18.81 feet. Gage readings are made once each day by Felix Beauchamp. The bed of the stream is covered with small bowlders and is rough but permanent. The current is swift. During the winter the channel is filled with ice, and it is impossible to make discharge measurements. The channel is nearly straight and is 194 feet wide between bridge abutments without piers.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Escanaba River near Escanaba, Mich., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 17[a]	E. Johnson, jr	194	799	3.18	4.25	2,546
June 2	do	194	719	2.95	3.82	2,120
August 9	do	194	396	0.83	2.04	329
September 4	do	194	527	1.69	2.91	891
October 11	F. W. Hanna	194	804	3.43	4.20	2,760

[a] Float measurement.

Mean daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.1	2.9	2.2	2.7	2.5	2.7	2.7
2		3.9	2.7	2.3	2.8	2.4	2.7	2.7
3		3.7	2.6	2.4	2.8	2.4	2.8	2.6
4		3.7	2.7	2.4	2.9	2.3	2.7	2.7
5		3.6	2.9	2.5	2.8	2.4	2.7	2.7
6		3.9	2.9	2.4	2.6	2.5	2.6	2.7
7		3.9	2.8	2.2	2.5	2.3	2.7	2.6
8		3.9	2.6	2.1	2.5	2.4	2.6	2.7
9		4.0	2.9	2.0	2.5	2.7	2.6	2.7
10		3.5	2.5	2.2	2.4	3.8	2.5	2.7
11		3.4	2.6	2.2	2.4	3.6	2.5	.....
12		3.2	2.6	2.3	2.3	4.2	2.5	.....
13		3.1	2.5	2.4	2.0	4.2	2.4	.....
14		2.9	2.5	2.5	2.4	3.4	2.4	.....
15		2.9	2.4	2.3	2.4	3.5	2.4	.....
16		2.8	2.6	2.4	2.6	3.2	2.5	.....
17		2.8	2.5	2.3	2.5	3.1	2.5	.....

Mean daily gage height, in feet, of Escanaba River near Escanaba, Mich., etc.—Cont'd.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
18	4.0	2.9	2.5	2.2	3.5	3.0	2.5	.....
19	4.0	3.4	2.4	2.1	3.4	3.1	2.6	.....
20	3.7	3.3	2.2	2.1	3.0	3.1	2.5	.....
21	3.8	3.3	2.1	2.2	3.1	2.9	2.5	.....
22	3.7	3.3	2.2	2.2	2.3	3.1	2.6	.....
23	9.0	3.1	2.5	2.3	2.2	2.9	2.6	.....
24	3.7	2.9	2.5	2.3	2.3	3.0	2.6	.....
25	3.9	2.8	2.5	2.3	2.5	3.1	2.5	.....
26	4.9	3.2	2.7	2.2	2.7	3.1	2.5	.....
27	5.4	3.1	2.5	2.2	2.5	3.1	2.1	.....
28	5.0	3.2	2.5	2.1	2.5	2.3	2.1	.....
29	4.7	3.3	2.4	2.1	2.5	3.0	2.5	.....
30	4.4	2.9	2.3	1.9	2.5	3.0	2.6	.....
31	4.5	.....	2.3	2.0	.....	2.9	.....	.....

Rating table for Escanaba River near Escanaba, Mich., from April 10, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	163	2.90	960	4.00	2,435	5.00	4,070
1.90	229	3.00	1,080	4.10	2,590	5.20	4,410
2.00	295	3.10	1,205	4.20	2,745	5.40	4,750
2.10	362	3.20	1,330	4.30	2,905	5.60	5,090
2.20	429	3.30	1,455	4.40	3,065	5.80	5,430
2.30	497	3.40	1,580	4.50	3,225	6.00	5,770
2.40	565	3.50	1,710	4.60	3,390	6.20	6,110
2.50	633	3.60	1,845	4.70	3,560	6.40	6,450
2.60	701	3.70	1,985	4.80	3,730	6.60	6,790
2.70	771	3.80	2,130	4.90	3,900	6.80	7,130
2.80	857	3.90	2,280				

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2 feet and 4.6 feet. The table has been extended beyond these limits. Above gage height 4.6 feet the rating curve is a tangent, the difference being 170 per tenth.

Estimated monthly discharge of Escanaba River near Escanaba, Mich., for 1903 and 1904.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
August 25–31	1,845	633	1,376	1.72	0.448
September	2,905	857	1,647	2.06	2.30
October	3,225	771	1,625	2.03	2.34
November 1–21	1,205	857	985	1.23	.960
1904.					
May 18–31	10,870	1,985	3,477	4.35	2.26
June	2,590	857	1,521	1.90	2.12
July	960	362	669	.836	.964
August	633	229	454	.568	.655
September	1,710	295	741	.926	1.03
October	2,745	497	1,145	1.43	1.65
November	857	362	657	.821	.916
December 1–10	771	701	757	.946	.352

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

Menominee River forms part of the boundary between Wisconsin and the upper peninsula of Michigan. It is formed by the junction of Brule and Michigamme rivers in T. 41 N., R. 31 W., and flows in a general southeasterly direction, entering Lake Michigan through Green Bay. The station was established September 4, 1902. It is located at the homestead highway bridge, 2½ miles south of Iron Mountain, Mich. The gage is a vertical board fastened to the right abutment; it is read twice each day by Theodore Moll. On November 18, 1904, a chain gage was established with the same datum as that of the board gage, and having a length of 28.19 feet from end of weight to the outside of the ring which is used as the marker. Discharge measurements are made from the single-span bridge to which the gage is attached. The channel is straight and has a width of 220 feet between bridge abutments. The current is moderate. The bed of the stream is composed of gravel and small bowlders. The bench mark is the top of the 12-inch timber bridge seat on the right abutment over the gage. Its elevation is 22.68 feet above the zero of the gage. During the winter the stream freezes beneath the bridge and it is difficult to obtain measurements in the frozen section. The drainage area at this station is 2,415 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 18	E. Johnson, jr	210	2,312	2.68	7.95	6,193
June 1	do	210	2,522	3.01	8.97	7,591
August 10	do	205	1,101	1.42	2.06	1,558
September 5	do	210	1,571	2.02	4.34	3,176
October 11	F. W. Hanna	225	2,408	3.20	8.25	7,714
November 18	E. Johnson, jr	210	1,511	1.94	4.02	2,925

Mean daily gage height, in feet, of Menominee River near Iron Mountain Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
1	.....	4.30	4.75	4.65	7.90	8.45	4.60	2.35	1.80	3.05	3.10	2.42
2	.....	4.25	4.70	4.55	7.95	6.95	2.35	3.30	3.15	2.75	3.65	2.20
3	3.20	4.30	4.55	4.35	8.70	5.65	2.20	2.90	3.70	2.65	4.10	2.22
4	2.90	4.50	4.10	4.60	9.70	6.30	2.90	3.00	4.95	2.45	3.75	2.25
5	2.70	4.30	3.90	5.10	8.15	9.60	2.80	1.30	4.30	2.75	3.25	2.55
6	2.75	4.25	4.50	4.85	9.70	7.30	3.70	2.70	4.00	2.85	3.50	2.50
7	2.75	4.20	4.90	4.70	8.50	8.80	3.60	1.30	4.10	2.55	3.80	2.30
8	3.20	4.20	4.80	4.65	10.40	7.50	3.60	1.20	4.10	2.90	4.85	2.92
9	3.60	4.25	4.70	6.05	11.95	8.55	4.20	1.45	3.70	3.80	4.10	2.95
10	3.50	4.00	3.95	6.20	(a)	8.50	3.30	3.20	3.15	6.70	3.10	2.97
11	3.45	3.90	3.50	4.10	11.80	7.50	4.10	3.80	2.90	7.60	3.20	2.75
12	3.20	3.95	3.00	3.80	11.10	6.70	4.20	4.40	3.10	8.25	3.20	2.50
13	3.10	3.90	3.15	3.65	10.70	6.70	1.80	4.00	2.55	7.80	3.25	2.32
14	3.40	3.85	3.30	3.70	10.55	5.90	4.30	1.90	2.85	7.35	3.05	2.27
15	4.25	3.95	3.25	3.75	9.65	5.40	3.75	2.05	3.50	6.40	2.95	2.32
16	4.30	3.80	3.00	4.10	9.05	4.95	4.30	3.70	3.40	5.90	3.05	2.32
17	4.30	3.75	3.05	3.95	8.10	4.60	1.65	3.60	2.80	5.55	2.80	2.47
18	4.35	3.75	3.35	4.25	8.15	4.50	3.25	4.00	3.15	5.30	3.85	2.50
19	4.35	3.70	3.45	4.40	8.15	3.70	3.05	3.10	2.60	5.20	3.15	2.47
20	4.40	3.90	3.15	4.30	6.25	3.50	2.50	3.15	2.70	5.00	2.92	2.27
21	4.15	3.75	3.15	4.35	4.90	3.50	4.30	2.40	2.95	5.00	2.90	2.22
22	4.10	3.60	3.40	4.40	6.15	4.40	2.70	3.65	2.30	5.05	2.67	2.42
23	4.25	3.60	3.45	5.45	6.10	3.70	2.30	3.45	2.55	5.05	2.77	2.37
24	4.25	3.55	3.75	6.05	7.05	3.70	1.30	3.90	3.80	5.15	2.85	2.40
25	4.20	3.65	4.55	7.35	8.25	5.45	2.75	3.90	3.90	5.05	2.75	.....
26	4.20	3.55	4.60	7.25	9.60	7.20	1.40	3.40	3.95	5.15	2.42	2.47
27	4.25	3.75	4.35	7.45	(a)	6.75	2.70	2.70	4.15	5.05	1.92	2.32
28	4.20	4.55	4.40	8.35	10.90	5.60	1.50	2.30	4.00	4.85	1.75	b 2.20
29	4.50	4.90	4.30	7.75	10.00	6.70	3.10	1.90	3.50	4.35	2.00	(b)
30	4.45	.....	4.55	9.40	8.70	6.70	1.45	2.05	3.37	4.30	2.07	(b)
31	4.35	.....	4.60	.....	8.00	.....	1.30	1.95	.....	3.90	.....	2.60

a Gage under water. b River frozen.

NOTE.—Probable ice conditions January, February, and March.

Rating table for Menominee River near Iron Mountain, Mich., from September 4, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	1,032	2.80	2,080	4.40	3,242	6.80	5,230
1.30	1,094	2.90	2,150	4.50	3,319	7.00	5,420
1.40	1,156	3.00	2,220	4.60	3,396	7.20	5,615
1.50	1,219	3.10	2,290	4.70	3,474	7.40	5,815
1.60	1,282	3.20	2,361	4.80	3,552	7.60	6,025
1.70	1,346	3.30	2,432	4.90	3,630	7.80	6,235
1.80	1,410	3.40	2,503	5.00	3,708	8.00	6,450
1.90	1,475	3.50	2,575	5.20	3,865	8.50	7,020
2.00	1,540	3.60	2,647	5.40	4,023	9.00	7,630
2.10	1,606	3.70	2,719	5.60	4,183	9.50	8,280
2.20	1,672	3.80	2,792	5.80	4,345	10.00	8,970
2.30	1,739	3.90	2,866	6.00	4,510	10.50	9,670
2.40	1,806	4.00	2,940	6.20	4,680	11.00	10,370
2.50	1,874	4.10	3,015	6.40	4,860	11.50	11,070
2.60	1,942	4.20	3,090	6.60	5,040	12.00	11,770
2.70	2,011	4.30	3,166				

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1902 to 1904, inclusive. It is not well defined. Above gage height 9.60 feet the rating curve is a tangent, the difference being 140 per tenth.

Estimated monthly discharge of Menominee River near Iron Mountain, Mich., 1902–1904.

[Drainage area, 2,415 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
September 4–30	1,772	1,032	1,295	0.536	0.538
October	2,625	1,094	1,596	.661	.762
November	5,306	1,806	2,829	1.17	1.30
December [a]	2,647	1,282	1,909	.790	.911
1903.					
January [b]					
February [b]					
March [b]					
April	6,780	1,705	5,175	2.14	2.39
May	11,560	4,698	7,496	3.10	3.57
June	8,020	1,540	3,417	1.41	1.57
July	6,670	1,806	3,553	1.47	1.70
August	7,630	2,467	4,049	1.68	1.94
September	10,650	2,575	5,091	2.11	2.35
October	6,130	2,719	4,057	1.68	1.94
November	3,669	1,874	2,505	1.04	1.16
December [a]	2,719	1,705	2,150	.890	1.03
1904.					
January [b]					
February [b]					
March [b]					
April	8,150	2,683	3,995	1.65	1.84
May [c]	11,770	3,630	7,879	3.26	3.76
June	8,410	2,575	4,791	1.98	3.21
July	3,396	1,094	2,196	.909	1.05
August	3,242	1,032	2,125	.880	1.01
September	3,669	1,410	2,488	1.03	1.15
October	6,725	1,840	3,650	1.51	1.74
November	3,591	1,378	2,293	.949	1.06
December [a]	2,199	1,672	1,838	.761	.877

[a] Conditions for December uncertain: rating table applied for open channel.
[b] Probable ice conditions; no estimate made.
[c] Discharge estimated for two days that gage was under water.

IRON RIVER NEAR IRON RIVER, MICH.

This station was established by the engineers of the Oliver Iron Mining Company. It is located at the mine bridge 1 mile below a dam used for ponding logs, which at times causes fluctuations. The gage is a vertical board attached to a braced cedar post at the left end and upstream side of the mine bridge. The gage-height record is kept by the engineers of the mining company. Discharge measurements are made from the mine bridge, which has a span of 30 feet between abutments. The bed of the stream is composed of gravel and small bowlders, and the current is swift. The stream rarely freezes over at the gaging station. The pumpage from the mine enters the stream a short distance above the gage; on September 5, 1902, it amounted to 1.7 second-feet. All gage heights have been expressed in terms of their elevation above the mine datum. The drainage area at this station is 63 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Mean daily gage height, in feet, of Iron River near Iron River, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	86.40	86.65	86.10	86.30	86.75	86.80	86.40	86.20	86.30	86.35	86.50	86.30
2	86.40	86.65	86.10	86.30	86.70	86.75	86.20	86.20	87.05	86.35	86.50	86.30
3	86.25	86.55	86.80	86.30	86.70	86.70	86.40	86.20	86.80	86.35	86.45	86.30
4	86.25	86.55	86.60	86.30	87.25	86.90	86.40	86.20	86.60	86.35	86.45	86.30
5	86.25	86.50	86.40	86.40	86.90	86.90	86.40	86.20	86.50	86.40	86.45	86.30
6	86.25	86.50	86.40	86.50	86.50	86.80	86.40	86.20	86.65	86.35	86.40	86.30
7	86.25	86.50	86.25	86.50	86.50	86.90	86.65	86.20	86.80	86.35	86.40	86.30
8	86.25	86.50	86.25	86.50	87.00	86.80	86.40	86.20	86.70	86.50	86.40	86.30
9	86.25	86.50	86.15	86.40	88.42	86.70	86.70	86.35	86.55	86.60	86.40	86.30
10	86.20	86.45	86.15	86.40	88.40	86.70	86.70	86.55	86.45	87.45	86.40	86.30
11	86.20	86.45	86.10	86.40	87.17	86.60	86.40	86.40	86.40	87.20	86.40	86.20
12	86.20	86.45	86.10	86.40	87.80	86.55	86.40	86.50	86.40	86.95	86.40	86.20
13	86.20	86.45	86.10	86.73	87.65	86.55	86.40	86.50	86.40	86.80	86.35	86.20
14	86.20	86.40	86.10	86.40	87.58	86.50	86.40	86.40	86.55	86.65	86.35	86.20
15	86.20	86.40	86.10	86.20	87.60	86.50	86.40	86.40	86.50	86.60	86.30	86.20
16	86.20	86.40	86.10	86.20	87.35	86.50	86.40	86.30	86.40	86.55	86.30	86.20
17	86.35	86.30	86.10	86.20	86.80	86.50	86.30	86.30	86.40	86.55	86.30	86.20
18	86.35	86.30	86.10	86.20	87.20	86.70	86.30	86.30	86.35	86.50	86.30	86.20
19	86.35	86.30	86.10	86.20	87.00	86.50	86.30	86.30	86.35	86.50	86.30	86.20
20	86.35	86.30	86.10	86.20	86.90	86.40	86.30	86.25	86.35	86.70	86.30	86.20
21	86.35	86.30	86.20	86.20	86.80	86.40	86.30	87.05	86.35	86.75	86.30	86.20
22	86.35	86.30	86.25	86.30	86.80	86.40	86.30	87.12	86.35	86.70	86.30	86.20
23	86.35	86.30	86.25	86.90	86.65	86.40	86.30	86.70	86.45	86.70	86.30	86.20
24	86.35	86.20	86.25	87.30	86.62	87.00	86.30	86.40	86.60	86.70	86.30	86.20
25	86.35	86.20	86.25	86.95	86.78	86.70	86.20	86.40	86.50	86.70	86.30	86.20
26	86.80	86.20	86.30	86.95	88.45	86.50	86.20	86.35	86.45	86.70	86.30	86.20
27	86.80	86.10	86.30	86.95	87.80	86.40	86.20	86.30	86.40	86.60	86.30	86.20
28	86.80	86.10	86.40	87.68	87.50	86.40	86.20	86.30	86.40	86.60	86.30	86.20
29	86.80	86.10	86.10	87.40	87.15	86.40	86.20	86.30	86.35	86.55	86.30	86.20
30	86.80	.....	86.20	87.30	87.15	86.40	86.30	86.30	86.35	86.50	86.30	86.20
31	86.80	.....	86.25	.....	86.80	.....	86.20	86.30	.....	86.50	.....	86.20

Ice conditions during portions of January, February, and March.

FOX RIVER AT WRIGHTSTOWN, WIS.

This station was established November 19, 1902, by L. R. Stockman. It is located at the highway bridge, about 2,000 feet from the Chicago and Northwestern Railway station. A small tributary enters just above the bridge on the right side. There are no dams nearer than Kaukauna, which is 6 miles up the river. There is a small island just above the bridge, near the right bank. The gage is a vertical board fastened to a pile in the protection to the central pier; it is read twice each day by Peter Van Lieshout. Discharge measurements are made from the upper side of the six-span highway bridge, to which the gage is attached. The initial point for soundings is a nail in the railing at the left end of the bridge. The channel is straight for 2,500 feet above and below the station. At the bridge the channel is 460 feet wide, broken by five piers. The right bank is low; the left bank is high, both being covered with grass to the water's edge. The entire flow passes beneath the bridge at all stages. The bed of the stream is of clay and loam, is without vegetation, and is permanent. The current velocity is moderate and well distributed. Bench mark No. 1 is a projecting stone in the northwest corner of the foundation of the American House at a point two-tenths of a foot above the sidewalk and 2 feet from the corner of the foundation. This building is located on the street that crosses the bridge. The elevation of the bench mark is 20.21 feet above the zero of the gage. Bench mark No. 2 is a cross in a limestone rock in the east end of the south bridge abutment. Its elevation above the zero of the gage is 12.46 feet. On the vertical face of this abutment is an arrow pointing upward to the bench mark. The drainage area at this station is 6,213 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Mean daily gage height, in feet, of Fox River at Wrightstown, Wis., for 1904.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	5.3	5.6	6.6	12	6.6	6.8	6.9	23	6.7	6.6	7.6
2	5.2	6.8	6.8	13	6.7	6.8	5.6	24	5.1	7.2	7.5
3	5.3	6.8	6.8	14	6.6	5.7	5.8	25	5.6	7.2	10.8
4	5.3	6.8	6.8	15	6.6	5.4	6.6	26	6.6	7.2	(a)
5	6.6	6.6	6.8	16	6.5	6.7	7.0	27	6.7	7.0	.....
6	6.4	6.7	5.5	17	5.4	6.7	7.1	28	6.8	5.4	.....
7	6.8	5.8	5.4	18	5.0	6.6	7.0	29	6.7	5.8	.....
8	6.8	5.4	6.8	19	5.9	6.7	7.1	30	6.7	.....	.....
9	6.8	6.7	7.0	20	6.4	6.6	5.8	31	5.8	.....	.....
10	5.6	6.7	7.0	21	6.4	5.8	5.8				
11	6.0	6.7	7.0	22	6.8	6.4	7.2				

(a) Gage destroyed.

NOTE.—Ice conditions January 1 to March 25. Gage heights to surface of water in hole cut in ice.

ST. JOSEPH RIVER AND PORTAGE CREEK AT MENDON, MICH.

This station was established October 25, 1902. It is located at the Marantette Bridge, near Mendon, Mich. The bridge has a single span of 136.5 feet between abutments, stands squarely across the direction of the current, and affords a fairly permanent cross section for gaging, the bed being of smooth clay. There is a bend in the stream a short distance above the bridge, but the channel below for some distance is straight. It is broken by an old bridge pier in the center, which causes eddying and some dead water. Little Portage River flows parallel to and about 1 mile distant from St. Joseph River at Mendon, and was at one time diverted across the divide, affording water power with a fall of 20 feet, but this has been discontinued. The drainage area above Marantette Bridge is 844 square miles. The gage is a vertical board attached to a cedar post near the water's edge in the village, about half a mile above the station. It is read twice each day by William P. McCoy. Little Portage River enters the St. Joseph between the gage and the measuring section and complicates the problem somewhat. The bench mark is the top of the head of a spike driven into the brick wall at the southeast corner of Masonic Hall building, 150 feet northwest from the gage. Its elevation is 19.95 feet above the zero of the gage. The growth of aquatic plants in the channel changes the relation of gage height to discharge during the summer.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of St. Joseph River at Mendon, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 3	Horton and Covert	468	1.73	1.50	810
June 7	R. E. Horton	455	1.53	1.35	697
September 9	H. R. Beebe	387	.83	1.38	322
September 22	do	389	.79	1.24	306

Discharge measurements of Portage Creek at Mendon, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 4	Horton and Covert	14.2	1.35	.....	19.2
June 7	R. E. Horton	14.1	1.23	.....	16.8

Mean daily gage height, in feet, of St. Joseph River at Mendon, Mich., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	1.60	.....	1.90	5.80	1.70	1.50	1.10	1.65	1.70	1.90	1.20	0.80
2	1.60	.....	2.00	5.70	1.70	1.50	1.10	1.70	1.65	1.75	1.20	.75
3	1.60	.....	3.00	5.50	1.55	1.50	1.10	1.60	1.60	1.65	1.20	.75
4	1.60	.....	3.50	5.15	1.50	1.50	1.10	1.55	1.50	1.60	1.20	.....
5	1.60	.....	[b]4.00	4.90	1.50	1.50	1.15	1.45	1.50	1.50	1.20	.....
6	1.60	.....	4.50	4.30	1.50	1.40	1.20	1.40	1.50	1.50	1.10	.....
7	1.60	.....	5.75	4.20	1.50	1.35	1.20	1.40	1.40	1.40	1.05	.85
8	1.60	.....	6.20	3.95	1.45	1.30	1.20	1.40	1.35	1.35	1.00	.90
9	1.60	.....	6.80	3.90	1.40	1.25	1.65	1.40	1.30	1.30	1.00	.90
10	1.60	.....	6.90	3.85	1.40	1.20	1.80	1.40	1.30	1.30	1.00	.95
11	1.60	.....	6.20	3.70	1.40	1.20	1.80	1.35	1.30	1.20	1.00	1.00
12	1.60	.....	6.00	3.65	1.40	1.20	1.95	1.30	1.40	1.20	1.00	1.00
13	1.60	.....	5.65	3.55	1.40	1.15	2.00	1.30	1.35	1.20	.95	1.00
14	1.60	.....	5.00	3.35	1.40	1.10	2.00	1.30	1.30	1.20	.85	.95
15	1.60	.....	4.95	3.30	1.40	1.10	2.00	1.30	1.25	1.20	.80	.90
16	1.60	.....	4.00	3.20	1.40	1.10	2.00	1.30	1.20	1.20	.80	.90
17	1.50	.....	3.90	3.10	1.40	1.10	1.95	1.32	1.20	1.20	.80	.90
18	1.50	.....	3.50	2.95	1.40	1.10	1.80	1.40	1.20	1.20	.80	.90
19	1.50	.....	3.50	2.75	1.50	1.10	1.70	1.40	1.20	1.20	.80	.90
20	1.50	.....	3.40	2.65	1.50	1.10	1.60	1.70	1.20	1.20	.80	.90
21	1.50	.....	3.40	2.40	1.50	1.10	1.50	1.90	1.20	1.20	.80	.90
22	1.50	.....	3.60	2.30	1.50	1.10	1.50	1.90	1.20	1.30	.90	.90
23	1.50	.....	4.70	2.30	1.40	1.10	1.50	1.90	1.20	1.30	.85	1.00
24	1.60	.....	5.65	2.30	1.40	1.10	1.50	1.90	1.20	1.25	.80	1.10
25	1.60	.....	[c]6.75	2.25	1.40	1.10	1.45	1.90	1.20	1.20	.80	1.20
26	1.70	.....	7.60	2.20	1.40	1.10	1.40	1.90	1.65	1.20	.80	1.40
27	1.80	.....	8.00	2.05	1.40	1.10	1.40	1.85	1.70	1.20	.80	1.40
28	1.80	.....	7.80	1.95	1.40	1.10	1.50	1.80	1.95	1.20	.80	1.40
29	1.80	.....	6.60	1.90	1.40	1.10	1.40	1.70	2.00	1.20	.80	1.40
30	1.80	.....	6.25	1.80	1.50	1.10	1.50	1.70	1.95	1.20	.80	1.40
31	.....	.....	5.90	.....	1.50	.....	1.55	1.70	.....	1.20	.....	1.40

[a] Ice conditions. Gage read to surface of water.
[b] Ice gorge.
[c] Flood caused by break in dams above.

ST. JOSEPH RIVER NEAR BUCHANAN, MICH.

A gaging station was established on St. Joseph River at the dam of the South Bend Electric Company, 1 mile below the village of Buchanan, April 1, 1901. The dam is of frame timber of the Beardsley type, 10 feet high, and rests on earth foundation, leakage being prevented by means of triple-sheet piling at the downstream toe. The upstream face of the dam has a slope of approximately 2.4 horizontal to 1 vertical. The downstream side is also faced with a sloping apron, the two slopes meeting at the crest at an angle of 90°. The dam is level and 392.5 feet in length. The crest gage is attached to piling 45 feet upstream from the crest and is read four times each day by Charles E. Babcock. On the left-hand side of the dam are two 35-inch Leffel turbines in separate vertical-cylinder cases connected to a single governor; from them power is transmitted to adjacent mills by manila rope. The average working head on the water wheels is

11.25 feet. A small amount of leakage through the dam existed in 1901, which was repaired during 1903, an estimate of the leakage was obtained, and a new profile taken.

In June, 1904, a new power plant was put in operation at this dam. The new plant contains three units, each containing three wheels. The turbines are 68-inch Leffel-Samson. The first and second units are controlled by Lombard governors. The third unit is controlled by hand. There is also a 40-inch Leffel-Samson turbine used to drive exciters. A record is kept of the number of hours per day each turbine unit is operated, and governor readings are taken every four hours, showing the proportional part of full gate opening at which the wheels are being operated. A record of the total electrical output in kilowatt hours is also obtained.

From November, 1903, to November, 1904, the record consisted of readings of the crest gage and of the Watt meter above described. The operation of the water wheels was not recorded. In order to calculate the discharge for this period, an estimate was made of the efficiency of the plant, based in part on tests, and the water required to furnish the recorded power under the existing head and at the assumed efficiency, was calculated and taken as representing the discharge through the turbines.

During the month of December, 1904, a careful record was kept both of the turbine operation and of the electrical output. The results furnish a check on the calculations for the preceding months.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of St. Joseph River near Buchanan, Mich., for 1903 and 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.[a]	June.[a]	July.[a]	Aug.[a]	Sept.[a]	Oct.[a]	Nov.	Dec.
1903.												
1	4,052	6,380	9,560	4,277	.....	.....	.....	.....	.....	.....	438	1,990
2	4,209	6,903	8,878	4,277	.....	.....	.....	.....	.....	.....	967	1,908
3	4,353	7,077	9,068	4,277	.....	.....	.....	.....	.....	.....	960	1,825
4	4,574	7,253	8,783	4,421	.....	.....	.....	.....	.....	.....	960	1,997
5	4,899	7,336	9,360	5,388	.....	.....	.....	.....	.....	.....	1,025	1,678
6	4,977	6,989	10,145	6,605	.....	.....	.....	.....	.....	.....	982	1,447
7	4,977	7,042	10,463	5,933	.....	.....	.....	.....	.....	.....	1,885	2,048
8	4,977	6,698	10,670	5,849	.....	.....	.....	.....	.....	.....	1,802	2,374
9	4,821	6,618	11,468	5,597	.....	.....	.....	.....	.....	.....	1,628	2,381
10	4,743	6,366	10,958	5,111	.....	.....	.....	.....	.....	.....	1,880	2,448
11	4,652	6,282	10,658	5,681	.....	.....	.....	.....	.....	.....	1,753	2,099
12	4,587	6,618	10,248	6,982	.....	.....	.....	.....	.....	.....	1,566	1,809
13	4,509	6,956	9,838	8,675	.....	.....	.....	.....	.....	.....	1,648	(a)
14	4,353	7,214	9,458	9,730	.....	.....	.....	.....	.....	.....	1,614	1,736
15	4,353	6,698	9,078	10,645	.....	.....	.....	.....	.....	.....	1,486	2,282
16	4,209	6,366	8,688	10,745	.....	.....	.....	.....	.....	.....	1,732	2,540
17	4,065	5,364	8,223	10,440	.....	.....	.....	.....	.....	.....	1,804	2,525

[a] Record not available.

Mean daily discharge, in second-feet, of St. Joseph River near Buchanan, Mich., for 1903 and 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.[a]	June.[a]	July.[a]	Aug.[a]	Sept.[a]	Oct.[a]	Nov.	Dec.
1903—Cont'd.												
18	3,908	4,146	7,918	10,030	.....	.....	.....	.....	.....	.....	2,042	3,080
19	3,777	3,382	7,654	11,102	.....	.....	.....	.....	.....	.....	1,982	3,102
20	3,777	3,178	7,302	9,055	.....	.....	.....	.....	.....	.....	1,946	3,374
21	3,637	3,586	6,956	8,480	.....	.....	.....	.....	.....	.....	1,931	3,641
22	3,637	4,058	6,782	7,905	.....	.....	.....	.....	.....	.....	1,569	3,626
23	3,707	4,734	6,702	7,115	.....	.....	.....	.....	.....	.....	2,076	3,448
24	3,777	5,862	6,534	6,689	.....	.....	.....	.....	.....	.....	1,864	3,913
25	3,764	5,694	6,114	6,521	.....	.....	.....	.....	.....	.....	2,012	3,427
26	3,849	5,445	5,445	6,211	.....	.....	.....	.....	.....	.....	2,000	2,716
27	3,993	5,862	4,968	5,681	.....	.....	.....	.....	.....	.....	1,753	2,460
28	4,137	7,128	4,890	5,351	.....	.....	.....	.....	.....	.....	1,691	3,080
29	5,385	.....	4,646	4,799	.....	.....	.....	.....	.....	.....	(a)	3,670
30	7,077	.....	4,578	4,421	.....	.....	.....	.....	.....	.....	1,997	3,087
31	6,225	.....	4,578	.....	.....	.....	.....	.....	.....	.....	.....	2,817
1904.												
1	3,045	9,872	10,650	16,300	4,648	4,014	(a)	.....	1,278	1,738	2,141	1,511
2	2,830	11,010	11,184	18,100	4,901	3,788	(a)	.....	1,274	950	2,376	1,476
3	2,574	9,006	10,120	15,345	4,634	3,492	2,802	.....	1,510	868	2,064	1,584
4	2,520	9,237	10,027	13,945	4,396	3,448	2,676	.....	1,352	1,317	2,017	1,089
5	2,692	10,165	10,487	12,871	4,192	3,132	2,970	.....	1,356	1,608	2,085	1,346
6	3,044	9,460	10,144	12,158	4,070	3,021	2,480	.....	1,476	1,620	1,830	1,624
7	3,016	8,430	11,524	11,484	3,942	3,012	2,559	.....	1,524	1,570	2,336	1,663
8	2,974	7,710	13,077	11,102	3,772	2,711	2,754	.....	1,394	1,626	2,053	1,582
9	3,059	7,166	12,934	10,529	3,928	2,520	2,725	.....	1,432	1,289	1,652	1,674
10	2,655	6,428	12,094	10,222	3,772	2,498	3,425	.....	1,331	1,475	1,848	1,693
11	2,953	5,624	12,941	8,618	3,772	2,579	3,342	.....	736	1,575	1,885	1,443
12	2,707	5,698	13,504	8,654	3,642	2,809	3,288	.....	1,380	1,712	1,727	1,615
13	2,504	5,604	11,134	8,452	3,554	2,548	3,152	.....	1,408	2,196	1,731	1,715
14	1,731	5,836	10,737	7,907	3,622	2,487	3,316	.....	837	2,333	2,236	1,589
15	2,238	5,954	9,909	6,977	3,526	2,173	3,027	.....	1,020	2,206	1,873	1,169
16	2,369	(a)	8,968	7,226	3,386	1,986	3,324	.....	1,380	1,780	1,259	929
17	4,964	3,968	9,165	6,851	3,044	1,690	3,451	.....	1,470	2,542	1,648	1,317
18	8,179	3,719	8,430	6,976	3,216	1,949	2,806	.....	774	2,329	1,598	1,135
19	7,654	3,610	8,099	6,872	3,274	2,552	2,659	.....	1,226	2,006	1,782	1,389
20	8,756	3,386	9,225	6,531	3,506	2,824	2,886	.....	1,379	2,076	1,818	1,683
21	9,964	3,263	10,283	6,019	3,737	2,747	2,452	.....	1,197	2,070	1,950	1,637
22	11,558	3,238	10,554	5,874	3,747	2,791	1,617	.....	1,271	2,076	1,725	1,683
23	12,857	3,336	12,209	5,715	3,556	2,718	1,991	.....	1,308	1,645	1,903	1,793
24	7,158	3,138	12,275	5,492	3,508	2,534	2,123	.....	1,214	2,501	1,930	2,135
25	10,131	3,004	13,882	5,758	3,312	2,703	2,339	.....	814	2,330	1,706	1,822
26	10,694	3,064	16,772	5,758	3,274	2,639	1,850	.....	1,096	2,160	1,754	2,015
27	9,408	3,132	18,602	5,962	3,492	2,592	1,788	.....	1,497	2,137	1,463	2,060
28	10,574	3,234	17,788	5,772	3,542	2,303	1,851	.....	1,462	2,099	1,895	1,650
29	9,792	5,926	16,430	5,408	3,300	2,261	2,065	.....	1,607	2,206	1,837	1,523
30	10,482	.....	15,668	5,152	3,846	2,086	2,184	1,945	1,754	1,628	1,712	2,049
31	6,355	.....	15,289	.....	3,959	.....	(a)	1,336	.....	2,292	.....	1,824

[a] Record not available.

Estimated monthly discharge of St. Joseph River near Buchanan, Mich., for 1903 and 1904.

[Drainage area, 3,935 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
January	7,077	3,637	4,450	1.13	1.30
February	7,336	3,178	5,973	1.52	1.58
March	11,470	4,578	8,084	2.05	2.36
April	11,100	4,277	6,933	1.76	1.96
May [a]					
June [a]					
July [a]					
August [a]					
September [a]					
October [a]					
November, 29 days [b]	2,076	438	1,620	.412	.459
December, 30 days [b]	3,913	1,447	2,609	.663	.765
1904.					
January	12,860	1,731	5,853	1.49	1.72
February, 28 days [b]	11,010	3,004	5,830	1.48	1.60
March	18,600	8,099	12,070	3.07	3.54
April	18,100	5,152	8,801	2.24	2.50
May	4,901	3,044	3,744	.951	1.10
June	4,014	1,690	2,669	.678	.756
July, 28 days [b]	3,451	1,617	2,639	.671	.774
August [a]					
September	1,754	736	1,292	.328	.366
October	2,542	868	1,870	.475	.548
November	2,376	1,259	1,844	.469	.523
December	2,135	929	1,594	.405	.467

[a] Records not available. [b] Mean for number of days observed taken as mean for entire month.

FAWN RIVER NEAR WHITE PIGEON, MICH.

Fawn River is a tributary of St. Joseph River, rising in northern Indiana near the Michigan line, flowing generally westward, crossing and recrossing from Michigan to Indiana, and entering St. Joseph River at Constantine. The drainage basin is flat with soil of sand and loam, and contains numerous lakes and undrained ponds, Klinger and Pickerel lakes being the largest and having water-surface areas of about 1 square mile each.

A gage was erected at the highway bridge below the abandoned Kidd mill dam, 4 miles from White Pigeon, July 4, 1903. The stream

stage has been observed twice daily, by William Probst, on a vertical graduated scale attached to the downstream left side of the bridge. Discharge measurements have been made from a boat at a point 500 feet downstream from the gage.

In the winter the stream freezes over at the gage and below, thereby changing the relation between the stage or discharge of the stream, as compared with open periods.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Fawn River near White Pigeon, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 3	Horton and Covert	124	1.73	2.10	215
June 7	C. C. Covert	116	1.59	2.00	182
September 10	H. R. Beebe	93	.99	[a] 1.95	92

[a] Distance to water surface from top right-hand anchor stake at measuring section.

Mean daily gage height, in feet, of Fawn River near White Pigeon, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	1.80	2.10	3.80	3.30	2.30	2.20	1.90
2	1.80	2.15	4.25	3.35	2.30	2.20	1.90
3	1.80	2.20	3.90	3.30	2.30	2.20	1.90
4	1.80	2.15	3.70	3.25	2.20	2.10	1.90
5	1.70	2.15	3.45	3.15	2.20	2.00	1.90
6	1.70	2.25	3.65	3.10	2.20	2.00	.....
7	1.70	2.75	3.60	3.00	2.10	2.00	.....
8	1.70	2.80	3.50	2.95	2.10	2.00	.....
9	1.70	2.80	3.35	2.95	2.10	2.00	.....
10	1.70	2.80	3.60	3.00	2.10	2.00	.....
11	1.70	2.80	3.45	3.00	2.05	2.00	.....
12	1.75	2.70	3.30	3.00	2.00	1.90	.....
13	1.75	2.65	3.25	2.90	2.00	1.90	.....
14	1.70	2.60	3.80	2.80	2.10	1.90	.....
15	1.70	2.50	4.30	2.80	2.20	1.85	.....
16	1.75	2.45	3.25	2.70	2.15	1.80	.....
17	1.80	2.40	3.05	2.60	2.10	1.80	.....
18	1.80	2.40	3.10	2.55	2.10	1.80	.....
19	1.80	2.35	3.00	2.50	2.15	1.85	.....
20	1.95	2.30	2.95	2.50	2.20	1.90	.....
21	2.10	2.30	3.00	2.50	2.20	2.00	.....
22	2.25	2.30	3.05	2.50	2.15	2.05	.....
23	2.40	2.30	3.25	2.50	2.10	2.10	.....
24	2.40	2.40	3.30	2.50	2.10	2.05	.....
25	2.35	2.40	3.30	2.50	2.10	1.95	.....
26	2.25	2.40	3.45	2.50	2.15	1.90	.....
27	2.20	2.30	3.45	2.45	2.20	1.90	.....
28	2.20	2.45	3.45	2.40	2.20	1.90	.....
29	2.20	3.30	3.30	2.40	2.10	1.90	.....
30	2.10	.....	3.30	2.30	2.15	1.90	.....
31	2.20	.....	3.30	.....	2.20	.....	.....

NOTE.—Ice conditions January 1 to March 2. Gage read to water surface.

KALAMAZOO RIVER NEAR ALLEGAN, MICH.

A gaging station was established at the dam of the Commonwealth Power Company, Trowbridge Township, 6 miles upstream by river from Allegan, April 4, 1901. The dam is of timber crib work filled with stone, resting on a pile foundation in clay hardpan. The dam is equipped with three Taintor segmental flood gates, each of 19.7 feet clear width. In the adjacent power house, forming a portion of the dam, are eight 43-inch Leffel-Samson turbines arranged in two sets on a horizontal shaft, each set controlled by a separate governor. The gaging record includes the number of hours of daily run; the average gate opening of the turbines, as indicated by the index wheels of the governors; the stage of water on the tailrace gage; and the reading of the crest gage. The crest gage is set with its zero at the elevation of the horizontal spillways of 20 feet crest width each, which are closed by the Taintor gates. The crest gage also serves to show the depth flowing over the crests of the Taintor gates or of flashboards placed thereon. A record of the opening and closing of the Taintor gates is also kept. The pond above the dam covers an area of 1,000 acres. The turbines run continuously and the flow of the stream is nearly all utilized, except in times of extreme freshet. At such times the water level is controlled by means of the flood gates described.

The crest and tailrace gages are set with a difference of elevation of 12 feet, and both are referred to the top of the masonry pier at the entrance to the flume as a bench mark. The elevation of the zero of the crest gage is 83.95 feet; that of the zero of the tailrace gage, 71.95 feet. The effective head varies from 21 to 23 feet.

The record is maintained in cooperation with the Commonwealth Power Company by R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of Kalamazoo River near Allegan, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	917	1,319	1,437	6,489	1,590	1,769	1,162	561	787	1,359	1,008	738
2	1,081	1,251	1,623	4,900	1,120	1,431	979	822	625	681	875	929
3	936	1,004	2,485	4,947	4,164	1,395	1,000	691	693	489	841	705
4	1,005	1,387	1,903	4,678	1,201	1,330	1,105	691	732	474	1,229	670
5	1,155	931	2,234	4,220	1,161	1,450	1,061	677	693	712	621	899
6	1,070	1,883	2,639	4,228	1,131	1,155	929	597	884	956	707	900
7	941	2,351	3,955	4,228	1,329	1,203	929	493	751	1,009	793	883
8	1,067	1,809	3,721	4,267	1,318	1,167	1,015	660	751	956	726	780
9	874	2,048	4,941	4,049	1,231	1,194	1,139	660	719	841	745	643
10	1,079	1,995	4,561	3,542	1,335	1,095	1,316	660	731	1,208	662	805
11	1,020	1,637	6,131	2,903	1,371	1,211	1,222	618	688	1,260	481	681
12	1,213	1,380	5,113	3,453	1,335	1,009	1,591	903	810	1,157	772	805
13	1,213	2,014	4,653	3,016	1,199	1,009	1,431	1,057	751	1,303	785	855
14	1,004	1,605	3,958	2,721	1,428	1,061	1,267	623	863	1,564	988	971
15	941	1,494	4,378	2,547	1,253	924	980	660	811	988	822	619
16	1,280	1,902	3,488	2,757	1,331	747	988	700	825	817	904	585
17	736	1,808	3,018	2,349	1,335	873	858	866	676	783	751	512
18	944	1,653	2,925	3,223	1,359	973	900	781	405	956	769	99

Mean daily discharge, in second-feet, of Kalamazoo River, etc.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
19	1,003	1,137	3,148	2,535	1,271	843	900	764	656	815	795	535
20	1,627	1,262	3,255	2,469	1,733	911	789	805	922	604	643	922
21	1,399	860	2,768	2,277	1,881	810	851	1,306	858	909	922	833
22	1,632	1,103	6,703	2,057	1,686	911	900	1,114	858	2,333	738	742
23	1,603	995	4,000	2,010	1,455	747	900	1,148	778	1,575	866	1,091
24	1,271	957	5,209	1,941	1,550	851	803	888	778	1,459	772	1,152
25	1,389	1,073	9,678	1,716	1,614	1,000	890	1,011	571	1,199	805	958
26	1,752	1,190	9,956	1,780	1,498	851	713	1,152	2,410	1,319	876	1,313
27	1,148	1,119	10,236	1,685	1,569	1,000	634	858	1,525	1,059	556	1,242
28	1,657	1,341	10,266	1,630	1,868	1,095	601	624	1,220	889	989	1,348
29	1,752	1,341	10,186	1,580	1,456	1,282	819	872	1,495	733	928	1,061
30	1,575	.....	10,006	1,704	1,484	1,122	721	923	1,545	931	791	638
31	1,384	.....	8,178	.....	1,653	.....	769	971	.....	1,099	.....	717

Estimated monthly discharge of Kalamazoo River near Allegan, Mich., for 1904.

[Drainage area, 1,471 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,752	736	1,215	0.826	0.952
February	2,351	860	1,443	.981	1.06
March	10,260	1,437	5,057	3.44	3.97
April	6,489	1,530	3,062	2.08	2.32
May	4,164	1,120	1,513	1.03	1.19
June	1,769	747	1,079	.734	.819
July	1,591	601	973	.661	.762
August	1,306	493	811	.551	.635
September	2,410	405	894	.608	.678
October	2,333	474	1,046	.711	.820
November	1,229	481	804	.547	.610
December	1,348	99	827	.562	.648
The year	10,260	99	1,560	1.06	14.46

GRAND RIVER AT NORTH LANSING, MICH.

This station was established March 2, 1901, by H. K. Vedder. It is located at the Seymour Street Bridge a short distance below the North Lansing dam. About November 8, 1901, a low, submerged dam was constructed a short distance downstream from the gaging station to supply water to the factory of the Michigan Beet Sugar Company. The diversion at this point is small compared with the flow of the stream. In order to determine the effect of the submerged dam on the gage readings, a second gage was established a short dis-

tance downstream and comparative readings were taken. The gage readings made prior to the construction of the dam have been corrected from the data thus obtained. The vertical gage is attached to the downstream end of the central pier of the bridge. It is read by Thomas Costigan. Discharge measurements are made from the two-span bridge to which the gage is attached. Each span has a length of 92 feet. During low water the bridge makes a slight angle with the normal to the direction of the current, at one side of the stream. The bed of the stream is composed of gravel and silt and is thickly overgrown with weeds above the bridge. The current becomes sluggish at low stages. The channel is nearly straight for 200 feet above and below the station.

Beginning October 19, 1904, gage readings have been taken at 6 a. m., noon, and 6 p. m. each day. The mean gage height for the day has been obtained by adding together twice the morning reading, the noon reading, and twice the afternoon reading, and dividing by 5. The different readings are thus given weight in proportion to the number of hours for which they are assumed to represent the stage of the stream.

Observations of the stage were taken at half-hour intervals during a portion of the low-water season of 1904, in order to determine the diurnal variation in stage and discharge resulting from the draft and storage at the mills and dam just above the gaging station. The half hourly observations were plotted, and the actual daily discharge was integrated from the diagrams by planimeter.

It was found that by using three daily readings in the manner above described the integral discharge could be closely approximated. The diurnal variation is a maximum in low water, decreasing in effect as the stage of the stream increases.

On March 26, 1904, a flood of unusual severity occurred, owing to the sudden melting of an unusually great accumulation of snow. The stage of the stream greatly exceeded the limit of the rating curve.

It is impossible to make meter measurements at the maximum stages, owing to the presence of ice and drift and to the high velocity. It is possible that the rating curve, as deduced, gives somewhat too large results for high stages, owing to the difficulty of holding the meter in position.

The dam just above the gaging station affords an opportunity to check the rating table for the higher stages and to extend it considerably. Arrangements have been made to procure a record at this dam during the spring freshet of 1905. When this has been done, it may be possible to calculate the discharge during the freshet of March 26, 1904.

The observed maximum stage, 18.55 on the gage, occurred at 6 a. m. March 26. The high-water mark at the North Lansing dam on the same date indicated a discharge of about 16,700 second-feet over the main spillway, which is 192 feet in length. In addition water flowed around both ends of the dam in an amount sufficient to increase the total discharge to somewhere from 20,000 to 25,000 second-feet.

During 1904 the United States Weather Bureau erected gages at various points along Grand River for use in predicting floods.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Grand River at North Lansing, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 25	C. C. Covert	734	1.67	3.90	1,239
May 28	R. E. Horton	631	1.61	3.45	1,020
June 9	C. C. Covert	466	1.29	2.50	600
September 2	H. R. Beebe	382	1.02	2.37	391
September 7	do	392	.91	2.27	357
September 18	do	154	.54	1.10	83
September 18	do	164	.55	1.20	92
December 17	C. C. Covert	342	.99	2.10	339

Mean daily gage height, in feet, of Grand River at North Lansing, Mich., for 1904.[a]

Day.	Jan.[b]	Feb.[b]	Mar.[b]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[b]
1	2.18	3.45	3.52	11.75	3.80	2.95	1.92	1.52	1.85	2.15	1.96	1.62
2	2.15	3.38	3.75	11.40	3.74	2.98	1.85	1.55	1.85	2.10	1.90	1.71
3	2.28	3.28	5.19	11.10	3.60	2.85	1.95	1.56	1.60	2.10	1.86	1.74
4	2.35	3.20	6.59	10.06	3.45	2.65	1.80	1.48	1.50	1.98	1.88	1.80
5	2.45	3.10	7.30	8.96	3.35	2.55	1.80	1.60	1.75	2.15	1.82	1.66
6	2.59	3.10	8.08	8.22	3.28	2.56	1.85	1.38	1.29	2.20	1.76	1.54
7	2.45	4.30	10.08	7.70	3.12	2.40	1.75	1.55	1.65	2.25	1.58	1.64
8	2.25	5.65	11.72	7.38	2.95	2.32	1.72	1.40	1.75	2.18	1.88	1.81
9	1.92	6.00	12.19	7.55	2.90	2.35	1.74	1.35	1.62	2.25	1.74	1.64
10	1.65	6.42	12.50	7.70	2.85	2.35	2.12	1.40	1.63	2.30	1.65	1.64
11	2.18	6.40	12.19	7.58	2.79	2.29	2.38	1.72	1.15	2.35	1.82	1.73
12	2.36	6.02	11.22	7.22	2.74	2.20	2.35	1.90	1.82	2.52	1.92	1.64
13	2.42	5.68	10.35	6.78	2.65	2.08	2.26	1.72	1.80	2.45	1.71	2.06
14	2.50	5.26	9.18	6.32	2.76	2.18	2.18	1.68	1.69	2.21	1.64	2.08
15	2.15	5.06	7.95	6.05	2.70	2.05	1.98	1.65	1.72	2.20	1.76	1.82
16	1.95	4.75	6.95	5.74	2.72	1.95	1.84	1.60	1.68	2.26	1.80	1.84
17	2.00	4.38	6.45	5.82	2.74	1.90	1.88	1.38	1.68	2.20	1.68	1.72
18	2.15	4.18	6.06	6.18	2.65	1.75	1.70	1.52	1.16	2.05	1.66	1.48
19	2.30	3.84	5.65	6.28	2.74	1.55	1.72	1.68	1.80	2.02	1.80	1.74
20	2.60	3.34	6.25	5.90	3.75	1.74	1.68	1.98	1.63	2.08	1.82	1.66
21	3.25	3.49	6.60	5.52	4.52	1.68	1.65	2.20	1.72	1.89	1.74	1.86
22	3.40	3.38	7.80	5.08	4.32	1.50	1.59	1.90	1.48	1.84	1.72	1.75
23	3.20	3.28	11.39	4.75	4.22	1.65	1.58	2.45	1.44	1.95	1.78	1.71
24	3.20	3.20	13.78	4.71	4.10	1.60	1.55	2.25	1.35	1.96	1.78	1.86
25	3.60	3.28	16.65	4.69	3.72	1.98	1.52	2.20	1.20	1.92	1.70	1.84
26	3.60	3.30	18.02	4.45	3.58	2.12	1.60	2.20	1.55	2.01	1.82	1.84
27	3.52	3.22	16.05	4.32	3.63	1.98	1.52	2.00	1.74	1.94	1.76	2.04
28	3.45	3.20	14.05	4.19	3.46	2.00	1.68	1.75	2.20	1.86	1.75	3.06
29	3.35	3.28	12.80	4.00	3.10	1.92	1.42	2.00	2.18	1.79	1.68	2.94
30	3.15	.....	10.86	3.84	3.05	1.95	1.38	1.75	2.25	1.96	1.89	2.51
31	3.05	.....	11.07	.....	3.00	.....	1.40	1.85	.....	1.80	.....	2.00

[a] Weighted mean of three readings per day, beginning October 19, 1904.
[b] Ice conditions January 1 to March 28; also December 13 to 31, but not sufficient to modify flow.

Rating table for Grand River at North Lansing, Mich., from March 8, 1901, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	80	2.70	596	4.30	1,340	6.80	3,010
1.10	108	2.80	634	4.40	1,400	7.00	3,170
1.20	136	2.90	672	4.50	1,450	7.20	3,350
1.30	164	3.00	710	4.60	1,510	7.40	3,540
1.40	192	3.10	754	4.70	1,570	7.60	3,730
1.50	220	3.20	798	4.80	1,630	7.80	3,930
1.60	248	3.30	842	4.90	1,690	8.00	4,130
1.70	276	3.40	886	5.00	1,750	8.20	4,360
1.80	304	3.50	930	5.20	1,870	8.40	4,590
1.90	332	3.60	980	5.40	2,000	8.60	4,840
2.00	360	3.70	1,030	5.60	2,130	8.80	5,110
2.10	392	3.80	1,080	5.80	2,260	9.00	5,380
2.20	424	3.90	1,130	6.00	2,390	9.50	6,120
2.30	456	4.00	1,180	6.20	2,540	10.00	7,010
2.40	488	4.10	1,230	6.40	2,690	10.50	8,000
2.50	520	4.20	1,290	6.60	2,840	11.00	9,000
2.60	558						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made from 1902 to 1904. It is fairly well defined between gage heights 1 foot and 5.5 feet. Above 5.5 the curve depends on ten scattered measurements at 10 feet approximately. Special corrections have been applied to discharge on account of temporary obstructions in the river. The table has been extended beyond these limits.

Location of United States Weather Bureau flood stations on Grand River, Michigan, and elevations of stream bed, flood, and danger lines.

[Compiled by C. F. Schneider, section director, United States Weather Bureau.]

	Jackson.	Eaton Rapids.	Lansing.	Grand Ledge.	Portland.	Ionia.	Grand Rapids.	Grand Haven.
High water Mar. 26–27, 1904:								
Above mean tide	(a)	837.36	828.50	793.40	712.79	640.27	608.31	(a)
Above gage zero	.....	9.20	19.45	14.01	14.44	27.55	20.45	.....
Danger line:								
Above mean tide	.....	864.16	819.10	785.39	709.93	637.27	598.59	.....
Above gage zero	5.00	6.50	10.85	6.50	11.58	24.55	10.73	.....
River bed and gage zero above mean tide	920	858.16	809.05	779.39	698.35	612.72	587.86	564.36
River fall (in feet)	61.84	49.11	29.66	81.04	85.63	24.86	23.5	.....
River distance (miles)	44.3	26.4	11.3	26.2	21.5	42.90	37.6	.....

a No gage.

Estimated monthly discharge of Grand River at North Lansing, Mich., for 1904.

[Drainage area, 1,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	980	262	589	0.479	0.551
February	2,708	754	1,319	1.07	1.16
March, 7 days	(a)	942	3,747	3.05	1.92
April, 26 days	(a)	1,105	2,729	2.22	2.15
May	1,465	577	854	.694	.798
June	700	220	410	.333	.372
July	480	185	302	.246	.283
August	504	178	291	.237	.273
September	440	122	265	.215	.240
October	530	304	391	.318	.366
November	346	241	297	.241	.269
December	732	164	325	.264	.304

a Above limit of rating table.

GRAND RIVER AT GRAND RAPIDS, MICH.

Grand River rises in northern Hillsdale County, in the vicinity of Bunday Hills. The headwaters of the Kalamazoo, St. Joseph, Raisin, and northern branches of Maumee River are in this same locality. Its principal tributaries are Flat, Maple, Lookingglass, and Cedar rivers from the north and Thornapple River from the south. Water power is extensively developed on the main stream and on certain of these tributaries. The drainage area is flat or moderately rolling, and comprises alternate areas of sand, loam, and clay. It is largely under cultivation, isolated timber areas remaining. Numerous small lakes and undrained hollows are located in the northwestern and southeastern parts of the drainage basin.

The station was established March 12, 1901, by L. W. Anderson, city engineer of Grand Rapids, Mich. The gage is attached to the upstream end of the ice breaker of the left bridge pier. The elevation of its zero is 0.55 foot below the city datum. All gage heights have been expressed as elevations above the city datum. Discharge measurements are made from the Fulton Street Bridge at which the gage is located. The channel is straight for several hundred feet above and below the bridge and is broken by three bridge piers. The gaging section is shallow and the bed is composed of cobblestones and gravel. The current is rapid and the velocity is poorly distributed at low stages.

The flood discharge of Grand River during March, 1904, exceeded all previous records, and the stage of the stream rose considerably above the limit of discharge measurements. An estimate of the discharge March 27, 1904, indicates that the flow was about 40,000 second-feet, or 8.2 feet per second per square mile from tributary drainage area of 4,900 square miles. The rating table for higher stages is subject to revision, having been estimated from a logarithmic formula based on data indicating somewhat higher discharge than would be obtained from the ordinary extension of the rating table.

The flood discharge of Flat River, tributary to Grand River, during the same flood, as estimated by Lyman E. Cooley, was 4,370 second-feet, or 7.15 second-feet per square mile from a tributary drainage basin of 610 square miles.[a]

During the year 1904 gages were erected by the United States Weather Bureau at various points along Grand River for use in predicting floods.[b]

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Grand River at Grand Rapids, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 31	Horton and Covert	2,095	2.05	2.05	4,288
September 12	H. R. Beebe	673	2.28	— .35	1,532

Mean daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.35	2.25	14.45	.....	1.70	0.65	−0.02	−0.50	0.50	0.25	−0.10
2	1.60	1.95	2.35	13.68	2.50	1.55	.35	— .08	— .10	.....	.15	— .15
3	.....	2.10	2.80	.....	2.30	1.40	.....	— .38	— .08	.10	.20	— .25
4	1.90	2.25	3.55	12.85	2.05	1.30	.....	— .48	.....	.32	.10	.....
5	1.60	2.15	4.50	12.08	1.92	.....	— .05	— .50	.....	.....	.10	— .35
6	1.60	2.20	.....	11.20	1.72	1.40	.05	— .32	— .32	1.05	.....	— .25
7	1.55	.....	6.25	10.50	1.55	1.15	— .08	.....	— .35	1.15	— .05	— .20
8	1.25	2.88	7.40	9.55	.....	.95	— .22	— .40	— .25	1.00	.05	— .20
9	1.40	3.38	8.25	9.40	1.45	.80	— .10	— .65	— .30	.....	.05	— .15
10	.....	3.98	9.28	.....	1.55	.65	.....	— .55	— .40	1.00	— .10	— .15
11	1.45	4.35	10.95	8.70	1.40	.40	— .10	— .48	.....	1.38	— .05	.....
12	1.45	4.35	12.05	8.60	1.30	.....	.02	— .65	— .40	1.40	— .10	— .30
13	1.35	4.22	.....	8.28	1.20	.20	.35	— .65	— .28	1.50	.....	— .20
14	1.40	.....	12.40	7.85	1.15	.28	.25	.....	— .48	1.38	— .10	— .10

[a] Report of L. E. Cooley, C. E., on flood conditions of Grand River at Grand Rapids, Mich., 1904.
[b] See page 36 for list.

Mean daily gage height, in feet, of Grand River at Grand Rapids, Mich., etc.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	1.30	3.80	12.15	7.32	.....	0.15	0.30	−0.55	−0.45	1.32	−0.08	0.00
16	1.30	3.70	11.70	6.82	1.05	.15	.20	− .50	− .50	.....	− .18	− .10
17	.....	3.56	11.30	.....	1.05	− .05	.....	− .50	− .45	.88	− .20	− .05
18	1.40	3.35	10.75	6.20	.95	− .15	− .20	− .55	.....	.95	− .10	.....
19	1.50	3.00	10.10	6.15	1.15	.....	.18	− .30	− .52	.70	− .05	− .05
20	1.45	2.80	.....	6.15	1.55	− .18	− .30	− .20	− .25	.55	.....	− .10
21	1.35	.....	9.20	6.00	2.00	− .35	− .25	.....	− .30	.65	− .05	− .05
22	1.45	2.60	9.30	5.68	.....	− .32	− .30	− .20	− .38	.80	.10	− .10
23	1.60	2.55	10.68	5.25	5.00	− .42	− .40	− .25	− .25	.....	− .05	− .02
24	.....	2.45	11.45	.....	5.30	− .45	.....	.10	− .15	.52	.....	.10
25	2.30	2.45	15.10	4.65	4.55	.00	− .40	.05	.....	.60	− .12	.....
26	2.25	2.45	18.10	4.38	3.85	.....	− .55	− .10	.65	.45	− .10	.....
27	2.15	2.45	19.30	4.00	3.35	.70	− .52	− .15	.90	.42	.....	.18
28	2.15	.....	19.17	3.75	3.00	.70	− .40	.....	.75	.40	− .25	.95
29	2.25	2.25	18.12	3.52	.....	.55	− .50	− .22	1.00	.35	− .15	1.25
30	2.25	.....	16.75	3.15	.....	.65	− .60	− .45	.65	.....	− .15	1.30
31	.....	.....	15.40	.....	2.10	.....	.....	− .55	.....	.10	.....	1.05

NOTE.—River considered frozen greater portion of January, February, March, and December. Gage heights to water surface. Sunday or holiday, no record.

Rating table for Grand River at Grand Rapids, Mich., from January 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.90	730	1.00	3,205	2.90	5,885	6.60	11,770
− .80	860	1.10	3,335	3.00	6,035	6.80	12,130
− .70	980	1.20	3,470	3.20	6,325	7.00	12,490
− .60	1,110	1.30	3,605	3.40	6,610	7.50	13,470
− .50	1,245	1.40	3,745	3.60	6,910	8.00	14,390
− .40	1,370	1.50	3,890	3.80	7,205	8.50	15,400
− .30	1,495	1.60	4,030	4.00	7,505	9.00	16,425
− .20	1,625	1.70	4,170	4.20	7,805	9.50	17,460
− .10	1,755	1.80	4,310	4.40	8,105	10.00	18,495
.00	1,885	1.90	4,450	4.60	8,410	10.50	19,530
.10	2,015	2.00	4,590	4.80	8,720	11.00	20,565
.20	2,140	2.10	4,730	5.00	9,025	11.50	21,600
.30	2,265	2.20	4,870	5.20	9,335	12.00	22,635
.40	2,405	2.30	5,010	5.40	9,670	12.50	23,670
.50	2,545	2.40	5,155	5.60	10,015	13.00	24,705
.60	2,675	2.50	5,305	5.80	10,350	13.50	25,740
.70	2,810	2.60	5,450	6.00	10,685	14.00	26,775
.80	2,945	2.70	5,595	6.20	11,015	15.00	28,895
.90	3,075	2.80	5,740	6.40	11,380	16.00	31,090

Estimated monthly discharge of Grand River at Grand Rapids, Mich., for 1904.

[Drainage area, 4,900 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April, 26 days	27,730	6,250	14,210	2.90	3.24
May, 25 days	9,490	3,140	4,907	1.00	1.15
June, 26 days	4,170	1,310	2,537	.517	.577
July, 25 days	2,740	1,110	1,732	.353	.407
August, 27 days	2,015	1,040	1,433	.292	.337
September, 25 days	3,205	1,210	1,748	.356	.397
October, 25 days	3,890	2,015	2,913	.594	.685
November, 25 days	2,200	1,560	1,821	.372	.415

Note.—Mean for number of days observed taken as mean for entire month. No estimate made for January, February, March, and December owing to ice conditions.

RED CEDAR RIVER AT AGRICULTURAL COLLEGE, MICH.

This gaging station was established August 30, 1902. The gage is located at the highway bridge just below the Agricultural College grounds. The bridge has a single span of 75 feet between abutments. The bed is of sand and gravel, fairly smooth and permanent. The channel is straight for a distance of about 400 feet downstream from the gage. A short distance upstream is a low dam forming an ice pond, below which the stream does not ordinarily freeze over. In this stretch of the river is the railroad bridge of the college spur of the Pere Marquette Railroad, from which gagings are made at high water or when the stream is frozen across at the gaging station. Near this bridge low-water measurements are also made by wading. The gage is of the usual wire type, and is attached to the downstream guard rail of the bridge. The upstream corner of the right-hand wing wall of the bridge abutment is used as a bench mark, with an arbitrary elevation of 100 feet. The elevation of the datum plane of the gage is 85.45 feet. The gaging station is situated about 4 miles from the mouth of the stream. Sycamore Creek, an important tributary, enters in this section. The drainage area above the gaging station is 358 square miles, and from the gaging station to the mouth of the stream 114 square miles, making the total above Grand River 472 square miles. The flow is sluggish at low stage and the station is subject to backwater from Grand River. Gage readings at this station were discontinued December 31, 1903.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Red Cedar River at Agricultural College, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
May 24	C. C. Covert	370	0.99	5.30	367
September 8	H. R. Beebe	27	.17	1.31	4.6

MUSKEGON RIVER AT NEWAYGO, MICH.

The drainage basin of this stream lies immediately north of that of Grand River. Originally it was covered with pine timber, but now it is almost entirely cleared. Much of the soil is sand and gravel, unfit for profitable cultivation. Large stump-covered areas form a conspicuous feature of the topography. The drainage areas tributary to Muskegon River are given in the following table:

Drainage areas of Muskegon River and tributary.

Stream.	Location.	Area.
		Sq. miles.
Muskegon River	Above Clam River	787
Clam River	Above mouth	307
Muskegon River	Below Clam River	1,094
Muskegon River	Above Big Rapids	1,764
Muskegon River	Above Newaygo	2,352
Muskegon River	Above mouth	2,663

In March, 1901, a station was established at the dam of the Newaygo Portland Cement Company. This dam crosses Muskegon River in a deep valley above the village of Newaygo. It is of timber, having framed cribs filled with stone. It is provided with a main spillway, with log ways, and with four flood ways. The flood ways are provided with Taintor segmental flood gates, which are operated by a traveling crab. A record is kept of the time and amount of opening of the flood gates and log ways, as well as the depth of water on the crests of the spillways. Ordinarily the flood gates and log ways are closed, and the entire flow passes over the main spillway or through the turbines. Water is carried from the pond to the power house by a short headrace separated from the stream channel by a crib breakwater.

The power house contained originally two turbine units. The number has recently been increased to four units. Each unit comprises four 35-inch Leffel-Samson turbine runners mounted on a horizontal shaft, and connected to the electrical generator by endless rope drives.

Each turbine unit is controlled by a Lombard governor and the gaging record includes a statement of the number of hours per day each unit is operated, together with the average gate opening. Beginning August, 1904, hourly readings of the governors have been taken. The wheels are ordinarily operated continuously twenty-four hours per day.

From the vicinity of Evart to Newaygo, Muskegon River flows between high banks and has a rapid fall. Levels which have been run for this purpose show that within a distance of 10 miles, 5 miles each way from Big Rapids, there is a total fall of 104 feet. Of this 16 feet is now utilized, leaving an available fall of 88 feet. There are favorable sites for the location of dams, so that practically the entire fall could be economically developed.

In connection with power development, good opportunities exist for the conservation of flow by artificial storage. The water-surface areas of the principal lakes of the watershed and of the tributary drainage which they control is given below:

Drainage and surface areas of lakes in Muskegon River watershed.

Lake.	Drainage area.	Water surface.
	Sq. miles.	*Sq. miles.*
Muskrat Lake and group	57	8.0
Clam Lakes	67	6.7
Higgins Lake	67	15.0
Houghton Lake (not including Higgins Lake)	185	31.0
Higgins and Houghton lakes	252	46.0

In the upper portion of the watershed there is a total lake area of about 110 square miles. Formerly a lumberman's dam was maintained for the purpose of flooding logs between Houghton and Higgins lakes, but this has been washed out. A lumberman's dam, built of logs and earth, which still remains about 1 mile below the foot of Houghton Lake, raises the water level in that lake 4 feet, providing a storage of, in round numbers, 3,350,000,000 cubic feet.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of Muskegon River at Newaygo, Mich., 1901–1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1						1,219	987	767	900	727	813	967
2						1,141	1,043	741	1,115	971	798	967
3						1,160	1,220	685	1,082	936	913	1,007
4						1,196	1,380	722	1,002	837	957	1,014
5						1,060	1,389	577	922	797	825	932
6						1,062	1,243	693	991	877	882	932
7						1,114	1,169	673	1,002	892	762	932
8						1,180	1,153	680	1,082	972	797	852
9						1,042	1,084	717	1,059	932	823	986
10						1,072	1,206	845	941	846	861	986
11						1,072	1,107	558	698	1,142	661	813
12						1,305	989	507	584	966	794	799
13						1,161	1,098	586	812	1,039	905	762
14						1,161	1,041	568	786	1,639	948	897
15						1,139	910	1,262	696	1,684	828	743
16						1,029	895	1,199	866	1,674	1,018	703
17						1,063	900	1,108	1,001	1,794	1,098	703
18						1,047	1,051	1,108	806	1,634	798	760
19						1,047	609	1,180	729	1,672	967	842
20						1,053	695	1,160	736	1,679	1,083	882
21						1,053	899	1,280	1,018	1,794	967	833
22						994	972	1,180	921	1,538	955	845
23						1,001	930	1,247	856	1,597	1,023	986
24						1,016	1,010	1,304	926	1,063	1,043	972
25						1,102	1,067	1,342	767	1,043	960	1,000
26						933	1,128	1,069	798	916	873	937
27						978	1,110	1,096	856	1,043	957	1,051
28						903	1,088	1,057	856	1,098	902	1,000
29						980	1,185	1,136	961	852	861	1,040
30						893	1,255	1,067	826	908	865	852
31							1,170	1,031		[a]860		986
1902.												
1	678	732	783	2,012	2,026	1,960	1,578	1,212	908	1,561	2,214	873
2	743	772	812	2,696	1,711	1,964	1,618	1,248	925	1,635	2,214	873
3	663	772	783	2,982	1,904	2,420	1,561	1,248	901	1,635	2,214	873
4	743	812	824	3,033	6,058	2,239	1,391	1,178	821	1,560	2,214	757
5	663	812	967	2,747	6,196	1,958	1,547	1,203	909	1,560	2,114	757
6	703	692	972	2,715	6,266	2,075	1,387	1,055	958	1,620	2,140	757
7	663	692	1,026	2,649	6,248	2,075	1,312	1,033	943	1,694	1,980	757
8	663	732	986	2,668	5,948	2,075	1,332	1,073	979	1,562	1,980	757
9	743	692	932	2,427	4,258	1,800	1,332	1,073	1,100	1,724	1,308	757
10	743	812	839	2,515	4,655	1,794	1,372	1,025	1,100	1,604	1,308	812
11	743	852	880	2,471	4,143	1,839	1,540	1,076	1,100	1,568	1,122	813
12	703	988	1,834	2,515	4,099	1,839	1,403	1,076	1,067	1,568	1,122	873
13	703	852	1,942	2,716	3,319	1,759	1,523	1,104	1,156	1,547	1,122	873
14	703	852	2,191	2,844	3,097	1,811	1,580	1,118	1,075	2,033	1,122	932
15	743	852	2,195	2,844	2,920	1,804	1,539	1,118	1,118	2,007	943	1,000
16	743	732	2,235	2,759	2,802	1,799	1,619	1,010	1,173	1,644	943	1,000
17	733	732	2,106	2,749	2,573	1,754	1,601	1,010	1,166	1,644	943	2,189
18	783	652	1,829	2,614	2,177	1,754	1,641	1,010	1,230	1,680	980	2,189
19	783	732	1,838	1,650	2,239	1,674	1,540	1,064	1,188	1,482	1,053	2,189

[a] Interpolated.

Mean daily discharge, in second-feet, of Muskegon River at Newaygo, Mich., etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
20	703	732	1,306	1,746	2,135	1,754	1,452	965	1,173	1,751	1,128	2,281
21	703	732	1,312	1,835	2,035	1,794	1,462	1,045	1,084	1,491	1,216	2,395
22	703	812	1,289	1,804	2,055	1,638	1,422	1,045	1,088	1,431	1,288	2,509
23	743	772	1,338	1,754	1,987	1,618	1,462	1,036	1,065	1,431	1,068	2,281
24	823	772	1,209	1,666	2,244	1,557	1,484	1,072	1,063	1,431	1,068	2,130
25	743	812	1,172	1,884	2,069	1,523	1,484	996	1,063	1,470	1,068	1,260
26	823	772	1,192	2,565	2,219	1,618	1,444	1,124	1,083	1,350	873	1,288
27	623	732	1,205	2,655	2,018	1,618	1,477	1,193	1,372	1,390	788	783
28	663	732	1,319	2,475	2,078	1,701	1,531	1,145	1,204	1,390	873	783
29	703	.....	1,186	2,387	2,018	1,539	1,531	1,118	1,135	1,390	873	1,323
30	703	.....	1,695	2,535	2,086	1,580	1,596	1,110	1,195	1,510	873	1,323
31	663	.....	1,577	.....	2,026	.....	1,676	1,158	.....	1,390	.....	1,323
1903.												
1	.....	2,015	1,215	2,066	2,498	.....	.....	.....	.....	.....	.....	.....
2	.....	2,253	1,155	2,110	2,772	.....	.....	.....	.....	.....	.....	.....
3	.....	2,020	1,335	2,344	2,498	.....	.....	.....	.....	.....	.....	.....
4	.....	1,889	1,500	3,344	2,434	.....	.....	.....	.....	.....	.....	.....
5	.....	1,695	1,688	5,006	2,314	.....	.....	.....	.....	.....	.....	.....
6	.....	2,135	1,665	3,969	2,814	.....	.....	.....	.....	.....	.....	.....
7	.....	1,960	2,508	4,255	2,171	.....	.....	.....	.....	.....	.....	.....
8	.....	1,852	3,517	2,946	2,220	.....	.....	.....	.....	.....	.....	.....
9	.....	1,829	4,159	3,005	2,220	.....	.....	.....	.....	.....	.....	.....
10	.....	2,300	4,390	3,071	2,220	.....	.....	.....	.....	.....	.....	.....
11	.....	2,343	4,528	2,886	2,160	.....	.....	.....	.....	.....	.....	.....
12	.....	2,343	4,259	2,886	2,139	.....	.....	.....	.....	.....	.....	.....
13	.....	2,214	4,223	2,886	2,139	.....	.....	.....	.....	.....	.....	.....
14	.....	1,970	4,280	2,945	2,079	.....	.....	.....	.....	.....	.....	.....
15	.....	1,932	4,962	5,055	2,019	.....	.....	.....	.....	.....	.....	.....
16	.....	1,851	4,926	5,116	1,914	.....	.....	.....	.....	.....	.....	.....
17	.....	592	4,500	4,768	1,914	.....	.....	.....	.....	.....	.....	.....
18	.....	847	4,311	4,798	2,000	.....	.....	.....	.....	.....	.....	.....
19	.....	847	4,301	4,570	2,000	.....	.....	.....	.....	.....	.....	.....
20	.....	860	4,232	3,049	2,000	.....	.....	.....	.....	.....	.....	.....
21	.....	933	4,503	3,108	1,672	.....	.....	.....	.....	.....	.....	.....
22	.....	1,082	4,267	3,139	1,794	.....	.....	.....	.....	.....	.....	.....
23	.....	1,147	4,393	2,640	2,032	.....	.....	.....	.....	.....	.....	.....
24	.....	1,128	4,267	2,780	1,912	.....	.....	.....	.....	.....	.....	.....
25	.....	1,060	4,252	2,780	1,914	.....	.....	.....	.....	.....	.....	.....
26	.....	1,027	4,536	2,351	2,365	.....	.....	.....	.....	.....	.....	.....
27	.....	967	4,267	2,411	2,245	.....	.....	.....	.....	.....	.....	.....
28	.....	1,120	4,418	2,286	2,365	.....	.....	.....	.....	.....	.....	.....
29	.....	.....	4,219	2,318	2,129	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	4,159	2,436	2,189	.....	.....	.....	.....	.....	.....	.....
31	.....	.....	4,207	.....	2,093	.....	.....	.....	.....	.....	.....	.....
1904.												
1	.....	.....	.....	.....	.....	.....	.....	1,593	674	947	1,098	807
2	.....	.....	.....	.....	.....	.....	.....	1,286	662	1,078	992	868
3	.....	.....	.....	.....	.....	.....	.....	1,276	582	970	982	769
4	.....	.....	.....	.....	.....	.....	.....	1,204	582	983	944	849
5	.....	.....	.....	.....	.....	.....	.....	1,234	546	1,090	954	1,049

Mean daily discharge, in second-feet, of Muskegon River at Newaygo, Mich., etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
6								1,026	690	898	993	1,013
7								1,042	702	910	1,044	853
8								1,078	630	946	1,028	989
9								1,050	618	1,060	846	1,051
10								1,024	678	1,040	989	928
11								1,092	856	1,374	1,004	708
12								1,077	820	1,489	876	799
13								1,065	748	1,268	862	724
14								1,053	789	1,088	1,031	984
15								993	885	1,160	964	904
16								1,017	850	943	1,160	1,006
17								1,050	844	1,015	1,052	1,065
18								1,051	796	955	1,087	836
19								1,001	798	983	1,004	800
20								1,077	922	971	1,030	908
21								1,113	820	1,096	992	980
22								1,126	937	1,181	1,063	1,076
23								1,051	869	1,030	1,054	967
24								1,086	892	1,004	1,054	898
25								918	802	1,175	1,090	897
26								991	706	1,067	1,142	956
27								979	668	1,054	909	789
28								932	1,122	957	887	968
29								932	940	1,172	922	1,079
30								954	925	906	724	1,134
31								933	.....	1,090	.....	943

Estimated monthly discharge of Muskegon River at Newaygo, Mich., 1901–1904.

[Drainage area, 2,352 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
June	1,305	893	1,073	0.456	0.509
July	1,389	609	1,064	.452	.521
August	1,342	507	939	.399	.460
September	1,115	584	886	.377	.421
October	1,794	727	1,175	.500	.576
November	1,098	661	898	.382	.426
December	1,051	703	904	.384	.443

Estimated monthly discharge of Muskegon River at Newaygo, Mich., 1901–1904—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	823	623	717	0.305	0.352
February	988	652	773	.329	.343
March	2,235	783	1,348	.573	.661
April	3,033	1,650	2,430	1.03	1.15
May	6,266	1,711	3,149	1.34	1.54
June	2,420	1,523	1,809	.769	.858
July	1,676	1,312	1,498	.637	.734
August	1,248	965	1,095	.466	.537
September	1,372	821	1,078	.458	.511
October	2,033	1,350	1,572	.668	.770
November	2,214	788	1,338	.569	.635
December	2,509	757	1,281	.545	.628
The year	6,266	623	1,507	.641	8.72
1903.					
February	2,343	592	1,579	.671	.699
March	4,962	1,155	3,715	1.58	1.82
April	5,116	2,066	3,244	1.38	1.54
May	2,772	1,672	2,153	.915	1.05
1904.					
August	1,593	913	1,075	.457	.527
September	1,122	546	778	.331	.369
October	1,489	898	1,061	.451	.520
November	1,160	724	993	.422	.471
December	1,134	708	920	.391	.451

MANISTEE RIVER NEAR SHERMAN, MICH.

Manistee River is the most northerly of the group of large rivers draining central Michigan and flowing westerly into Lake Michigan. The fall of the stream is very gradual, and no important utilization of water power has been made, the principal use of the stream being for rafting logs. Manistee, at the mouth of the river, affording an excellent harbor, is an important lumber center. The drainage basin is sandy and the stream receives a very large portion of its supply from ground storage through springs along the river bank and along the tributaries.

A chain gage was established at North Bridge, near Sherman, July 10, 1903. The stage of the stream is observed twice each day by Lincoln Jewell. Current-meter discharge measurements are made at the bridge, which consists of a single span; the stream bed is of clay and sand and has some logs in it, as is frequently the case with rivers used for lumbering. It also becomes frozen over in the winter, so that the relation between the gage height and discharge is modified for that season.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Manistee River near Sherman, Mich., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 4	W. M. Gregory	344	2.64	.....	935
July 10	do	368	2.79	[a] 2.45	1,043
July 24	Horton and Gregory	354	2.96	[a] 2.49	1,050
July 24	W. M. Gregory	358	2.97	[a] 2.55	1,060
August 26	do	347	2.86	[a] 2.30	994
1904.					
June 2	C. C. Covert	538	2.82	3.62	1,514
September 13	H. R. Beebe	335	2.77	2.05	921
September 16	do	359	2.70	2.06	907
September 16	do	359	2.72	2.05	912
December 14	C. C. Covert	362	2.38	1.76	860

[a] Superseding gage heights as given in the 1903 report.

Corrected mean daily gage height,[a] in feet, of Manistee River near Sherman, Mich., for 1903 and 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1	.....	.....	.....	.....	.....	.....	.....	2.50	3.00	2.58	2.46	2.39
2	.....	.....	.....	.....	.....	.....	.....	2.35	2.90	2.68	2.46	2.24
3	.....	.....	.....	.....	.....	.....	.....	2.45	2.80	2.68	2.46	2.24
4	.....	.....	.....	.....	.....	.....	.....	3.40	2.80	2.88	2.46	2.44
5	.....	.....	.....	.....	.....	.....	.....	4.25	2.70	2.78	2.46	2.44
6	.....	.....	.....	.....	.....	.....	.....	4.25	2.70	2.78	2.46	2.44
7	.....	.....	.....	.....	.....	.....	.....	3.90	2.70	2.78	2.46	2.44
8	.....	.....	.....	.....	.....	.....	.....	3.60	2.80	2.78	2.56	2.44
9	.....	.....	.....	.....	.....	.....	.....	3.30	2.85	2.88	2.76	2.44
10	.....	.....	.....	.....	.....	.....	2.55	3.05	3.05	2.78	2.71	2.54
11	.....	.....	.....	.....	.....	.....	2.45	3.00	3.10	2.78	2.56	2.39
12	.....	.....	.....	.....	.....	.....	2.40	3.00	3.10	2.78	2.96	2.24
13	.....	.....	.....	.....	.....	.....	2.35	3.10	3.00	2.68	2.96	8.64

[a] Superseding gage heights as given in the 1903 report.

Corrected mean daily gage height, in feet, of Manistee River, etc.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
14							2.35	3.05	3.10	2.58	2.96	3.39
15							2.35	2.95	3.10	2.58	2.96	3.29
16							2.35	2.85	3.20	2.63	2.86	3.24
17							2.35	2.80	3.20	2.88	2.86	3.24
18							2.25	2.65	3.20	3.18	2.86	3.14
19							2.15	2.45	3.10	3.18	2.76	3.14
20							2.15	2.45	3.05	3.03	2.61	2.79
21							2.35	2.35	2.90	2.93	2.56	2.64
22							2.60	2.35	2.89	2.78	2.56	2.54
23							2.65	2.25	2.75	2.68	2.66	2.54
24							2.50	2.25	2.70	2.68	2.61	2.54
25							2.55	2.32	2.60	2.58	2.51	2.44
26							2.50	2.30	2.55	2.58	2.41	2.54
27							2.45	2.30	2.60	2.58	2.36	4.54
28							2.50	2.35	2.60	2.48	2.31	3.79
29							2.80	2.60	2.60	2.48	2.36	3.74
30							2.75	2.90	2.60	2.48	2.41	3.69
31							2.60	2.95	.....	2.48	.....	3.54
1904.												
1	3.52	2.40	2.58	4.31	4.84	3.82	2.50	2.38	1.97	2.25	2.35	2.15
2	3.52	2.40	2.58	4.41	4.69	3.72	2.50	2.38	2.17	2.25	2.25	2.05
3	3.07	2.40	2.58	4.36	4.54	3.47	2.50	2.38	2.22	2.20	2.25	1.95
4	2.92	2.40	2.38	4.21	4.34	3.42	2.50	2.28	2.27	2.25	2.25	1.95
5	2.92	2.40	2.53	4.21	4.19	3.42	2.50	2.23	2.17	2.30	2.15	1.90
6	2.92	2.50	2.48	4.41	3.99	3.42	2.50	2.33	2.07	2.25	2.15	1.95
7	2.92	2.50	2.43	4.66	3.89	3.42	2.50	2.38	2.07	2.25	2.15	2.00
8	2.92	2.40	2.48	5.11	3.84	3.42	2.40	2.33	2.07	2.40	2.15	2.05
9	2.82	2.30	2.53	5.49	4.09	3.32	2.40	2.38	2.07	2.45	2.15	2.00
10	2.82	2.25	2.43	6.19	4.44	3.17	2.40	2.43	2.07	2.55	2.15	1.95
11	2.67	2.30	2.38	6.19	4.44	3.02	2.40	2.48	2.07	2.60	2.15	2.00
12	2.62	2.30	2.38	6.13	4.54	3.02	2.40	2.38	1.97	2.65	2.15	2.05
13	2.62	2.25	2.38	5.61	4.44	2.92	2.40	2.43	2.02	2.75	2.35	1.90
14	2.62	2.30	2.18	5.21	4.19	2.92	2.40	2.48	2.05	2.65	2.40	1.78
15	2.62	2.20	2.23	4.86	3.99	2.92	2.80	2.58	2.00	2.55	2.25	1.95
16	2.62	2.15	2.28	4.46	3.79	2.92	2.85	2.63	1.95	2.55	2.15	2.30
17	2.42	2.20	2.28	4.36	3.69	2.82	2.80	2.58	1.95	2.45	2.15	2.00
18	2.02	2.25	2.28	4.31	3.64	2.72	2.70	2.48	2.15	2.35	2.15	2.05
19	1.97	2.35	2.28	4.71	3.54	2.62	2.60	2.43	2.25	2.25	2.15	2.10
20	2.37	2.35	2.23	4.36	3.64	2.62	2.45	2.38	2.25	2.25	2.15	2.20
21	2.47	2.40	2.28	4.26	3.64	2.57	2.35	2.38	2.15	2.25	2.05	2.10
22	2.62	2.30	2.28	4.11	3.69	2.52	2.30	2.38	2.05	2.25	2.05	2.10
23	2.62	2.35	2.38	4.11	3.74	2.52	2.30	2.23	2.05	2.25	1.95	2.25
24	2.37	2.40	2.48	4.41	3.64	2.57	2.30	2.33	2.30	2.35	1.95	2.35
25	1.87	2.45	2.73	4.91	4.24	2.52	2.30	2.38	2.45	2.35	2.00	2.30
26	2.07	2.35	3.68	5.46	4.44	2.52	2.35	(a)	2.35	2.35	1.95	2.25
27	2.27	2.40	3.38	5.61	4.44	2.52	2.40	(a)	2.55	2.35	1.95	2.30
28	2.32	2.50	3.08	5.56	4.59	2.47	2.40	2.08	2.55	2.35	1.80	2.20
29	2.47	2.50	3.08	5.21	4.49	2.52	2.40	2.03	2.45	2.35	1.90	1.85
30	2.42	.....	3.18	4.96	4.29	2.52	2.40	1.98	2.35	2.35	2.15	2.20
31	2.42	.....	3.78	.....	4.04	.....	2.40	1.98	.....	2.30	.....	2.20

a Log jam.

BOARDMAN RIVER AT TRAVERSE CITY, MICH.

A gage was erected on Boardman River at Upper Union Street Bridge July 14, 1903, and the stream stage was observed twice daily by D. McLachlan. The record was furnished by Traverse City. Boardman River drains a generally level sand-covered area tributary to Lake Michigan through Grand Traverse Bay. The upper drainage basin is 10 miles in breadth, tributaries are few, and there are a small number of undrained lakes and ponds. Near the mouth the drainage area becomes much narrower and the fall is rapid, water power being utilized to some extent. Boardman Lake lies above Traverse City, at an elevation of about 25 feet above Lake Michigan. The outlet of the lake makes an abrupt bend and flows parallel with the water front of Traverse Bay for one-half mile above its outlet. A dam furnishes power for a flour mill, drawing its water supply from Boardman Lake. In order to avoid, as far as possible, backwater from Traverse Bay the gage was placed near the foot of the dam. The discharge measurements have been made by current meter at the Park Place Bridge near the mouth of the river.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Boardman River at Traverse City, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 2	R. E. Horton	282	1.36	9.65	382
June 2	do	281	1.30	9.67	364
September 14	H. R. Beebe	334	1.14	9.35	380
September 14	do	334	1.03	9.44	344
September 15	do	321	1.24	[b]9.54	398

[a] Distance to water surface from reference point, Park Place Bridge.
[b] Gage height approximate.

LAKE HURON DRAINAGE BASIN.

South of Saginaw Bay the Lake Huron slope is very narrow and is drained by brooks and runnels a few miles in length. The so-called Thumb of the Mitten is drained by three streams which flow northwest, known as the Willow, Pinnepog, and Pigeon, lying in a flat, marshy region.

The drainage surrounding Saginaw Bay is included in the Saginaw River system.

Northward from Saginaw Bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excellent ground storage in

sand areas, and well-sustained flow. The rainfall is less than on the western or Lake Michigan slope of the State.

Cheboygan River also belongs in the Lake Huron drainage.

The following pages give the results of data collected during 1904 in Lake Huron drainage basin:

THUNDER BAY RIVER NEAR ALPENA, MICH.

Thunder Bay River is tributary to Lake Huron at Alpena, Mich. The drainage basin is largely underlain by fissured limestone, more or less overlain with sand, and covered with dwarfed timber. The original pine forest has been largely lumbered. The drainage basin contains numerous small lakes in the region of the headwaters; it also contains Hubbard Lake, having a water surface of 13.4 square miles. The regimen of the stream is comparatively steady, but is more or less influenced by the operation of lumbermen's dams.

A gaging station was established at the dam of the Fletcher Paper Company, 4 miles above Alpena, April 4, 1901. The run-off for years preceding 1904 will be found in Water-Supply Paper No. 83, pages 289–293, and Water-Supply Paper No. 97, pages 436–433. The record includes two readings each day of the depth on the crest gage, located 75 feet upstream from the head-gates, opposite the left end of the dam. The dam is of timber, practically water-tight, and is usually surmounted by flashboards. It contains, in addition to three spillways, sections of lengths 90, 105, and 181.5, and a log slide 40 feet in width. The crest of the dam was originally level, but settlement of the middle section has made it necessary to subdivide the spillways into several short sections, each assumed level at its average elevation, for purposes of calculation. The discharge over the main dam has been computed by the weir formula, using coefficients derived from Cornell University experiment No. 13 of the United States Deep Waterways Board, for a dam of similar cross section. Discharge over flashboard sections has been calculated by means of the Francis formula. There is also a subsidiary logway and a headrace overflow, the latter 3 feet in width, the flow through which has been computed by suitable formulas. The adjoining pulp and paper mill has 14 pairs of 26-inch Trump model turbines, arranged in three groups, each containing four turbines on horizontal shafts, with one double horizontal turbine. The daily run of the turbines and the working head on the wheels, which is determined from readings of the crest and tailrace gage, is also recorded.

The observations of this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of Thunder Bay River near Alpena, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	533	677	518	1,985	3,299	2,494	474	462	380	481	399	522
2	483	683	502	2,251	3,175	2,254	534	391	393	206	415	312
3	310	677	502	4,953	2,930	2,137	460	299	421	631	449	458
4	521	645	521	4,591	1,939	1,724	54	342	206	478	429	292
5	503	657	546	4,822	1,875	1,757	549	358	243	505	439	470
6	470	577	(a)	6,421	1,679	2,084	544	404	397	461	216	489
7	479	370	571	6,934	1,513	2,387	542	206	533	503	524	518
8	488	633	596	6,927	745	2,556	524	502	402	426	449	498
9	467	655	571	7,275	1,580	2,569	548	470	501	23	428	473
10	359	646	579	6,940	1,471	2,579	178	548	524	631	338	451
11	511	643	589	6,592	1,524	2,303	538	577	206	503	397	279
12	516	602	639	6,095	1,548	2,012	532	577	561	548	371	453
13	480	549	(a)	6,427	1,470	1,992	588	592	490	705	45	478
14	504	402	(a)	4,730	1,428	1,697	624	280	410	610	538	478
15	482	605	677	4,233	747	1,321	634	609	475	572	479	443
16	477	559	665	3,502	1,464	1,377	504	545	461	378	702	417
17	298	578	512	3,077	1,383	1,233	23	548	404	721	529	400
18	496	552	669	2,909	1,582	1,313	638	551	132	594	478	282
19	475	546	664	2,993	2,145	1,089	563	543	518	524	422	451
20	491	480	(a)	2,930	2,211	1,042	524	541	509	520	290	440
21	502	363	673	2,772	2,521	827	503	169	525	482	546	442
22	522	633	705	3,429	2,932	740	436	582	433	558	515	468
23	484	583	823	2,802	3,187	866	503	510	415	206	536	488
24	323	588	739	2,467	3,206	706	54	532	496	415	556	284
25	532	579	883	3,121	2,913	582	545	535	321	379	609	595
26	534	526	971	3,545	3,255	269	460	552	572	446	484	290
27	556	485	1,284	4,393	3,234	662	433	581	520	501	473	496
28	614	(a)	1,600	4,466	4,219	661	404	22	511	343	450	491
29	576	589	1,477	4,555	3,267	504	420	587	493	629	325	515
30	518	.....	1,524	3,594	3,125	491	427	471	487	253	493	491
31	325	.....	1,615	.....	2,414	.....	547	415	.....	535	.....	511

a Record not available.

Estimated monthly discharge of Thunder Bay River near Alpena, Mich., for 1904.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	614	298	478	0.379	0.437
February, 28 days	683	363	574	.456	.475
March, 27 days	1,615	502	800	.635	.638
April	7,275	1,985	4,391	3.48	3.88
May	4,219	745	2,254	1.79	2.06
June	2,579	269	1,474	1.17	1.31
July	638	23	461	.365	.421
August	609	22	461	.365	.421
September	572	132	428	.340	.379
October	721	23	476	.378	.436
November	702	45	444	.352	.392
December	595	279	441	.350	.404

AU SABLE RIVER AT BAMFIELD, MICH.

Au Sable River rises in southern Otsego County, flows south to Grayling, thence east to the west line of Alcona County, from which point it follows a tortuous course in a general southeasterly direction to its outlet in Lake Huron at Oscoda. Its drainage basin embraces a region at one time noted for the abundance of white pine. The area is now almost entirely cleared of its valuable native timber and contains a large extent of sandy plains covered with shrub conifers. There are also areas of diversified soils, pink clay, loam, and gravel. The basin is underlain by Coldwater shales. Rock outcrops are very rare, the stream bed being usually clay or sand.

The basin contains numerous small lakes, wet sand areas, and undrained hollows, the topographic features being mainly the work of the retreating ice of the Glacial epoch.

At Bamfield, about 40 miles from the outlet, following the river, the elevation is about 850 feet above sea level. From this point to the mouth of the stream excellent sites for water-power development occur. These water powers are favored by a stream bed of firm clay, the river being flanked in many places with high terraced clay bluffs, rising often 60 to 100 feet above the stream. In some places the upper half or two-thirds of the bluff is sand, the lower portion being clay. At the clay horizon numerous springs appear. The tributaries are not important, nearly all the rainfall being directly absorbed by the porous sand areas. The drainage area above the junction of the two branches of Au Sable River is 1,005 square miles; above the gaging station at Bamfield, 1,425 square miles; and above its mouth at Oscoda, 1,932 square miles.

A gaging station was established at the highway bridge at Bamfield August 27, 1902, and gage readings have been taken twice each day since that date. The observer is William H. Bamfield. The gage is a vertical scale graduated to feet and tenths, attached to the left side of the left pier supporting the main bridge span on the downstream side. The bridge has three spans, one a main Pratt truss span of 92 feet, with flood channels at ends. One truss is supported on trestle work that is clogged with drift. Only a small part of the flow, however, passes through this channel at high water. The channel is straight for 800 feet below the station, and in this distance slight rifts occur. It is straight for 500 feet above the gage. The channel has a width at ordinary stage of 140 feet. The bed of the stream is composed of sand and gravel, and is somewhat rough, with sunken logs and short piles, but is permanent. The velocity is moderate to rapid. The banks are low and are skirted on the right by a flood plain, which is, however, seldom overflowed. Beyond the flood plain on the right, and close to the river on the left, are high gravel banks.

The stream seldom freezes over in winter so that the relation of gage height to discharge differs little from that in summer. Anchor ice backs the water up at times, however. Wire spikes, driven into the upstream end of the left pier, serve as a temporary bench mark. Its elevation is 8.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Au Sable River at Bamfield, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 28	C. C. Covert	823	3.19	3.30	2,569
June 10	do	653	2.79	2.20	1,823
September 5	H. R. Beebe	466	2.29	1.00	1,066

Mean daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.70	4.40	4.00	2.25	3.35	2.00	1.75	1.20	1.00	1.05	0.95	1.05
2	2.70	4.40	4.00	2.30	3.10	2.00	1.75	1.25	1.00	1.15	1.00	1.10
3	2.70	4.40	4.00	2.50	2.75	2.05	1.70	1.25	.95	1.20	1.00	1.10
4	3.00	4.40	4.00	2.50	2.70	2.05	1.60	1.30	1.00	1.20	1.00	1.10
5	3.40	4.40	4.00	2.70	2.60	2.05	1.45	1.30	.95	1.15	.95	1.20
6	3.20	4.40	3.60	2.90	2.50	2.25	1.40	1.30	1.00	1.00	.90	1.20
7	3.00	4.40	3.60	3.10	2.40	2.30	1.40	1.35	.95	1.05	1.00	1.20
8	3.00	4.40	3.50	3.30	2.45	2.25	1.40	1.35	1.00	1.10	1.00	1.15
9	3.00	4.45	3.50	3.50	2.60	2.20	1.35	1.40	1.00	1.15	.95	1.10
10	3.00	4.40	3.50	3.75	2.70	2.15	1.40	1.25	1.00	1.25	.90	1.20
11	3.00	4.40	3.50	4.05	2.85	2.10	1.50	1.30	1.00	1.60	.95	1.05
12	2.80	4.40	3.50	4.40	3.00	2.10	1.40	1.25	1.00	1.75	1.00	1.00
13	2.70	4.40	3.50	4.50	3.05	2.05	1.30	1.25	1.00	1.65	.95	1.10
14	2.70	4.40	3.50	4.27	3.05	2.00	1.45	1.30	1.00	1.50	.90	1.20
15	2.70	4.40	3.50	4.03	3.00	1.95	1.40	1.40	1.00	1.35	1.00	1.20
16	2.70	4.40	3.50	3.93	2.90	1.80	1.30	1.35	1.00	1.25	1.00	2.40
17	3.40	4.40	3.40	3.53	2.80	1.75	1.25	1.35	1.00	1.10	1.00	2.65
18	4.00	4.40	3.40	3.40	2.75	1.75	1.30	1.25	1.00	1.10	1.00	2.95
19	4.10	4.40	3.30	3.13	2.65	1.65	1.20	1.20	1.00	1.05	.90	3.55
20	4.30	4.20	3.30	2.97	2.75	1.45	1.30	1.20	1.10	1.00	.95	4.60
21	4.35	4.20	3.30	2.80	2.80	1.30	1.25	1.20	1.15	1.00	1.00	4.00
22	4.35	4.20	3.20	2.87	2.85	1.20	1.25	1.35	1.00	1.00	1.00	4.25
23	4.30	4.10	3.00	2.80	2.90	1.30	1.25	1.30	1.00	1.05	1.05	4.00
24	4.30	4.00	2.90	3.30	3.00	1.25	1.25	1.30	1.00	1.05	1.00	3.45
25	4.30	4.00	2.85	4.10	3.35	1.30	1.20	1.20	1.00	1.00	1.00	3.45
26	4.30	4.00	2.70	4.53	2.75	1.20	1.25	1.20	1.05	1.00	1.00	3.50
27	4.30	4.00	2.60	4.40	2.30	1.25	1.40	1.10	1.20	1.00	1.05	3.50
28	4.30	4.00	2.50	4.10	2.30	1.25	1.55	1.00	1.15	1.00	1.15	3.40
29	4.30	4.00	2.20	3.77	2.25	1.35	1.35	.90	1.00	1.00	1.10	3.50
30	4.30	.....	2.00	3.63	2.15	1.65	1.30	.95	1.00	1.05	1.10	3.40
31	4.30	.....	2.00	.....	2.10	.....	1.30	.95	.....	1.00	.....	3.40

NOTE.—Ice conditions January 16 to March 22, and December 14 to 31.

Rating table for Au Sable River at Bamfield, Mich., from August 27, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	875	1.70	1,460	2.90	2,260	4.00	3,130
.60	919	1.80	1,520	3.00	2,340	4.10	3,210
.70	963	1.90	1,570	3.10	2,410	4.20	3,300
.80	1,000	2.00	1,630	3.20	2,490	4.30	3,390
.90	1,050	2.10	1,700	3.30	2,570	4.40	3,480
1.00	1,100	2.20	1,760	3.40	2,650	4.50	3,560
1.10	1,140	2.30	1,830	3.50	2,730	4.60	3,650
1.20	1,200	2.40	1,900	3.60	2,810	4.70	3,740
1.30	1,240	2.50	1,960	3.70	2,890	4.80	3,840
1.40	1,300	2.60	2,040	3.80	2,970	4.90	3,930
1.50	1,340	2.70	2,110	3.90	3,050	5.00	4,020
1.60	1,400	2.80	2,190				

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1902 to 1904, inclusive. It is fairly well defined between gage heights 0.70 foot and 3.50 feet. The table has been extended beyond these limits. Above gage height 3.50 feet the rating curve is based upon logarithmic extension.

Estimated monthly discharge of Au Sable River at Bamfield, Mich., 1902–1904.

[Drainage area, 1,425 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
August 27–31	1,030	1,000	1,006	0.706	0.131
September	1,120	1,000	1,008	.707	.789
October	1,460	1,000	1,067	.749	.864
November	1,700	1,050	1,352	.949	1.06
December	1,460	1,200	1,299	.912	1.05
1903.					
January [a]					
February [b]					
March 4–31 [c]	2,530	1,100	2,030	1.42	1.64
April	2,410	1,570	1,938	1.36	1.52
May	1,600	1,240	1,380	.968	1.12
June	1,200	1,070	1,117	.784	.875

[a] Ice conditions January 7 to 19. [b] Ice conditions February 18 to March 3.
[c] Mean for 28 days taken as mean for entire month.

Estimated monthly discharge of Au Sable River at Bamfield, Mich., 1902–1904—Cont'd.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
July	1,300	1,050	1,124	.789	.910
August	2,080	1,000	1,465	1.03	1.19
September	1,630	1,140	1,436	1.01	1.13
October	1,320	1,140	1,228	.862	.994
November	1,140	1,100	1,107	.777	.867
December 1–14 [a]	1,300	1,100	1,184	.831	.433
1904.					
January [b]					
February [b]					
March 23–31 [b]	2,340	1,630	1,994	1.40	.469
April	3,580	1,800	2,698	1.89	2.11
May	2,610	1,700	2,142	1.50	1.73
June	1,830	1,200	1,506	1.06	1.18
July	1,490	1,200	1,290	.905	1.04
August	1,300	1,050	1,212	.851	.981
September	1,170	1,070	1,108	.778	.868
October	1,490	1,100	1,175	.825	.951
November	1,170	1,050	1,094	.768	.857
December 1–13 [c]	1,200	1,100	1,155	.811	.392

[a] Probably ice conditions December 15 to 31. [b] Ice conditions January 16 to March 22.
[c] Ice conditions December 14 to 31.

NOTE.—During frozen period gage heights are to water surface in hole cut in ice.

RIFLE RIVER AT OMER, MICH.

Rifle River rises in the vicinity of Rose City, northern Ogemaw County, flows southward to the northwest corner of T. 19 N., R. 4 W., turns easterly, and then gradually to the southeast, and finally enters Saginaw Bay. The basin is heavily overlain with glacial deposits, sand, overwash gravel, and till. There are two old lumber dams in the basin and a water-power dam at Omer. There are numerous small glacial lakes, but no controlled storage, and a very small percentage of natural water surface in the drainage basin. The basin is narrow and elongated, having a width of about 3 miles at the mouth. Ramifying tributaries in the headwaters give the stream a relatively large volume at the entrance of West Branch, in T. 21 N., R. 3 E. At Omer the stream falls from an elevation of 608 to 595 feet over a dam, affording power for a grist and saw mill. The drainage area at Omer is 364 square miles, and at the mouth of the stream is 385 square miles.

The gaging station was established September 1, 1902. It is located at the Detroit and Mackinaw Railroad bridge, one-half mile below the dam in Omer village. The gage is a wire gage with a boxed scale, graduated to feet and tenths, and is attached to the downstream guard rail of the bridge. The regular gage readings were discontinued December 31, 1903. The bridge has a single span of 109 feet. The bed is of sand and fine drift. The channel is curved and does not pass beneath the bridge at right angles. The bed is stony on the concave and sandy on the convex side, with some piles and sunken logs in between. The bench mark is on the right corner of the left bridge abutment on the downstream side. Its elevation is 15.75 feet above gage datum.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Rifle River at Omer, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 27	C. C. Covert	363	2.37	7.35	855
September 4	H. R. Beebe	142	1.26	4.68	179
September 6	do	175	1.61	4.96	279
September 6	do	160	1.20	4.66	157

TITTABAWASSEE RIVER AT FREELAND, MICH.

Tittabawassee River forms the most northerly of the three tributaries which join to form Saginaw River at Saginaw. Their combined catchment areas receive the drainage from a crescent-shaped region of about 6,000 square miles surrounding Saginaw Bay. Tittabawassee River drains an area relatively flat, with clay soil predominating, and with occasional sand patches; the glacial sands and clay overlying the rock of the Coal Measures to a depth of several hundred feet. The area is largely cleared and under cultivation. From railroad profiles, the fall of the stream from Highwood to its mouth, a distance of about 50 miles along the river, is estimated at 140 feet.

The gaging station was established August 22, 1903, by W. M. Gregory. It is located at Freeland highway bridge, 10 miles northwest of Saginaw, in sec. 21, T. 13 N., R. 3 E., one-half mile from Freeland, Mich. The bridge consists of two main spans 320 feet between abutments, an auxiliary trestle span of 150 feet, and two overflow channels under the highway, some distance from the right end of the bridge. The gage is a standard chain gage, bolted to the upstream side of the iron guard rail, 180 feet from the left end. The length of

the chain from the end of the weight to the marker is 31.33 feet. The gage is read twice each day by W. E. Dennison. Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The downstream hand rail is painted and numbered at 5-foot intervals. The initial point for soundings is the left end of the hand rail, on the downstream side of the bridge. The channel is straight above and below the station. The current is uniform and has a medium velocity. It may be affected at times by strong winds, which have a free sweep through the valley. The right bank has a flood plain which is inundated only at extreme flood stages. The left bank is high and smooth and is not subject to overflow. The bed of the stream is composed of clay and cobblestones and is fairly permanent, but tends to cut near the left bank. Bench mark No. 1 is the top of a nail head 1 foot below the top of the cedar corner post of the road fence in front of the blacksmith shop on the left bank. Its elevation is 32.96 feet above gage datum. Bench mark No. 2 is a circle inclosing the letters "B. M." painted on the top of the downstream end of the left pier. Its elevation is 22.88 feet above gage datum. The elevation of the top of the gage pulley is 31.33 feet, and that of the reference point, the top of the hand rail over the pulley, is 31.50 feet above gage datum.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Tittabawassee River at Freeland, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Sec.-feet.*
May 26	C. C. Covert	2,394	2.54	6.62	6,499
June 10	R. E. Horton	1,239	1.65	3.35	2,047
September 3	H. R. Beebe	748	.81	1.35	597
September 6	do	727	.62	1.13	454
September 20	do	769	.70	1.30	536
September 20	do	787	.67	1.28	526
December 13	C. C. Covert			2.00	[a]576
December 15	do			2.10	[a]611

[a] Measurement made through ice.

Mean daily gage height, in feet, of Tittabawassee River at Freeland, Mich., for 1904.

Year.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.[a]	Dec.[a]
1	2.70	3.15	4.15	14.50	5.17	3.22	1.88	1.75	1.22	1.50	1.82	1.36
2	2.62	3.20	4.20	14.80	4.37	2.95	1.95	1.95	1.28	1.62	1.85	1.52
3	2.55	3.20	4.20	13.90	4.02	3.00	2.00	1.98	1.38	1.70	1.80	1.65
4	2.50	3.25	4.30	12.80	3.99	3.18	2.00	2.10	1.28	1.78	1.75	1.80
5	2.60	3.30	4.40	11.60	3.87	3.22	1.92	1.82	1.18	1.85	1.68	1.82
6	2.68	3.30	4.45	10.75	3.57	4.15	1.82	1.75	1.12	2.00	1.65	1.88
7	2.70	3.25	4.55	9.20	3.07	4.48	1.80	1.62	1.35	1.85	1.72	1.95
8	2.80	3.30	4.85	9.50	3.07	4.40	1.85	1.70	1.52	1.72	1.62	2.02
9	2.88	3.35	5.10	10.15	3.07	4.18	1.90	1.62	1.52	1.75	1.62	2.10
10	2.90	3.35	5.60	10.75	3.27	3.55	1.92	1.52	1.42	1.95	1.70	2.15
11	3.00	3.40	6.20	10.60	3.62	3.15	1.95	1.45	1.32	2.25	1.68	2.12
12	3.02	3.40	6.75	10.20	3.62	2.85	2.05	1.42	1.25	2.60	1.68	2.10
13	3.10	3.40	7.00	9.68	3.47	2.65	2.30	1.40	1.05	2.90	1.72	2.10
14	3.05	3.45	7.00	9.32	3.49	2.45	2.15	1.32	1.15	2.75	1.70	2.00
15	3.00	3.45	7.15	7.60	3.39	2.25	1.95	1.22	1.38	2.38	1.72	2.00
16	2.95	3.50	7.22	7.15	3.32	2.08	1.82	1.20	1.40	2.18	1.68	2.00
17	2.90	3.50	7.30	7.05	3.12	1.95	1.68	1.28	1.35	2.05	1.75	2.00
18	2.85	3.45	7.30	8.55	3.12	1.82	1.60	1.30	1.30	1.78	1.68	2.00
19	2.90	3.50	7.15	9.95	3.29	1.72	1.52	1.38	1.32	1.82	1.70	2.05
20	3.00	3.52	6.95	10.07	3.52	1.70	1.45	1.42	1.48	1.85	1.72	2.10
21	3.10	3.55	7.10	9.02	4.12	1.70	1.40	1.48	1.58	1.75	1.70	2.15
22	3.10	3.60	7.75	7.92	4.19	1.62	1.45	1.35	1.50	1.80	1.70	2.18
23	3.02	3.60	8.25	7.07	5.72	1.58	1.50	1.30	1.60	1.82	1.78	2.25
24	2.95	3.60	9.50	6.69	8.27	1.60	1.48	1.38	1.70	1.82	1.70	2.32
25	2.90	3.65	12.70	7.22	8.22	1.70	1.40	1.50	1.80	1.90	1.65	2.40
26	2.88	3.70	17.30	7.79	7.62	1.62	1.35	1.45	1.72	1.92	a1.62	2.42
27	2.90	3.70	18.25	7.22	6.88	1.58	1.30	1.42	1.82	1.85	1.48	2.48
28	2.80	3.85	16.50	6.62	5.92	1.50	1.48	1.28	1.90	1.78	1.32	2.48
29	2.95	4.05	14.90	5.92	5.12	1.58	1.42	1.18	1.75	1.72	1.25	2.42
30	3.10	.....	13.85	5.52	4.38	1.75	1.42	1.08	1.58	1.75	1.28	2.41
31	3.10	.....	13.80	.....	3.60	.....	1.55	1.22	.....	1.82	.....	2.44

[a] Frozen January 1 to March 28 and November 26 to December 31.

FLINT RIVER AT FLINT, MICH.

This station was established September 9, 1903, by W. M. Gregory. It is located at the Grand Trunk Railway bridge at Flint, Mich. A plain board gage graduated to feet and tenths is attached to piles on the inside of a row of piling 34 feet from the right abutment. It is read twice each day by F. J. Lowlery. Discharge measurements are made from the Smith Street Bridge above or the South Street Bridge below the railway bridge, the first having a single span of 129.5 feet and the latter a single span of 105 feet. The initial point for soundings at the Smith Street Bridge is the face of the left abutment on the downstream side. At the South Street Bridge it is the left end of the iron guard rail on the downstream side. The channel is straight for a short distance above and below the station. The current is moderate. Both banks are composed of earth, clean, and seldom, if ever, overflow.

The bench mark is a point marked on the top of the downstream guard rail of the railway bridge to which the gage is attached, 34 feet from the right end. Its elevation is 18.47 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Flint River at Flint, Mich., in 1903.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet. per sec.*	*Feet.*	*Second-feet.*
September 9[a]	W. M. Gregory	350	2.06	[b]15.75	721
September 9	do	330	1.91	1.10	632

[a] Durrant and Dort Bridge above gage.
[b] Distance to water surface from top of iron guard rail, downstream side, 13 feet from left end.

Mean daily gage height, in feet, of Flint River at Flint, Mich., for 1903 and 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1										0.70	0.25	−0.20
2										1.00	− .30	− .30
3										1.10	− .45	− .30
4										1.25	− .15	− .30
5										1.35	− .10	− .30
6										1.05	− .10	− .30
7										.95	− .10	− .35
8										1.85	− .10	− .40
9									1.10	1.65	− .10	− .40
10									.95	1.40	− .10	− .40
11									.80	1.25	− .15	− .40
12									.70	1.15	.05	− .50
13									.70	1.05	.25	− .40
14									.70	.95	.35	− .20
15									1.45	.75	.20	− .30
16									2.65	.70	.45	− .20
17									4.40	.50	.55	− .20
18									4.05	.60	.60	− .30
19									3.60	.55	.75	− .30
20									3.35	.50	.00	− .20
21									3.10	.50	.10	− .20
22									2.90	.40	.10	− .20
23									2.65	.40	.10	− .20
24									2.30	.40	.15	− .20
25									1.90	.30	.10	− .10
26									1.35	.20	− .05	− .10
27									1.05	.10	− .30	.00
28									.85	.10	− .40	− .20
29									.70	.05	− .25	− .10
30									.60	.00	− .10	− .10
31										.00		− .10

Mean daily gage height, in feet, of Flint River at Flint, Mich., etc.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
1	−0.10	−0.20	0.20									
2	− .10	− .20	.45									
3	.00	− .20	1.85									
4	.10	− .20	1.96									
5	.00	− .10	2.15									
6	.00	.25										
7	− .10	.85										
8	− .10	1.05										
9	− .10	1.70										
10	− .10	1.90										
11	− .10	2.05										
12	.00	2.00										
13	.00	1.95										
14	− .05	1.95										
15	− .10	1.85										
16	− .10	1.75										
17	− .10	1.55										
18	− .20	1.40										
19	− .20	1.25										
20	− .20	1.05										
21	− .20	.95										
22	− .20	.85										
23	− .20	.70										
24	− .20	.65										
25	− .20	.55										
26	− .20	.45										
27	− .20	.37										
28	− .20	.30										
29	− .20	.25										
30	− .20											
31	− .20											

LAKE ERIE DRAINAGE BASIN.

The Lake Erie drainage basin is conspicuous by the lack of any large streams which flow through it, this being due to the comparatively short distance from the lake to the divide between it and its adjacent drainage areas. The largest stream is the Maumee, which is formed in the northeast part of Indiana by the junction of St. Joseph and St. Mary rivers, and flows northeast, entering Lake Erie at the northwest corner of Ohio.

Huron River is tributary to the west end of Lake Erie, near the mouth of Detroit River. The Huron receives drainage from an irregular-shaped basin having its greatest length parallel to, and lying at a distance of 25 to 30 miles from, Detroit River. This basin is connected with Lake Erie by a long, narrow valley averaging 5 miles in width, and extending from a point near Ypsilanti southeasterly to Lake Erie, a distance of 28 miles. In this portion of its course, a large part of

the total fall of the river occurs. The conditions are thus nearly ideal for the development of water power, in that nearly the entire catchment area, all the large tributaries, and an extensive area affording lake and ground storage, lie above the head of the narrow valley referred to.

The drainage basin below Ypsilanti is flat, the soil comparatively heavy and impervious, mostly under cultivation, the ground water level being controlled by means of numerous drain trenches.

In the vicinity of Ann Arbor the topography is very rolling. The stream flows through a broad, flat valley bordered by abrupt hills 100 to 200 feet in height. The channel is tortuous and changeable. Numerous abandoned sections remain as bayous. Large streams issue from the morainal hills.

On the right-hand or southwesterly side, the main catchment basin above Ann Arbor is moderately rolling and comprises a very large percentage of marsh area. There are a few small lakes and a considerable number of undrained depressions. The numerous branching tributaries have been cleaned to facilitate drainage, and main drainage channels have been excavated through the marsh.

The northerly portion of the main catchment basin is rolling and its topography complex. The stream flows through a series of lakes, and the entire basin is largely comprised of lakes and surrounding marshes north of Dover.

An investigation of the water power of Huron River was made by Lyman E. Cooley, C. E., in 1904, and the following results of miscellaneous measurements of Huron River have been collected and furnished by Mr. Cooley:

Discharge May 7, 1898, deduced from surface-velocity measurements in Osborne mill, by A. A. Weber and M. A. Wood, 261.6 second-feet.

Discharge at Argo mill, deduced by M. H. Freeman and F. M. Rademacher, from average gage reading at Swift's dam, Ann Arbor, April 21 to May 4, inclusive, 1903, was 807.4 second-feet; the maximum discharge observed during the summer period was 1,775 second-feet.

Discharge at Flat Rock measured by W. T. Sherman, September 11, 1903, 688.6 second-feet. Water level above normal.

Discharge at Geddes dam, Ann Arbor, Mich., June 15, 1903, estimated by L. E. Cooley from depth on spillway and run of turbine was 424 second-feet. Flood discharge of July 7, 1902, at Geddes dam, Ann Arbor, estimated by L. E. Cooley, was 5,510 second-feet.

In addition to the above, the following miscellaneous measurements have been made by W. M. Gregory:

August 4, 1904, at lower highway bridge, Ann Arbor, discharge 134 second-feet. Water surface 16.35 feet below top of iron handrail, 75 feet from zero mark on bridge, downstream side.

August 4, 1904, discharge at Dover, Mich., 116 second-feet.

During the winter of 1903–1904 a survey of Huron River was made, under the direction of L. E. Cooley, by H. B. Alexander. Data were

obtained at various dams along the stream, from which the following data of discharge have been computed:

Discharge of Huron River in winter of 1903–1904.

Name of dam and locality.	Date.	Discharge.	Drainage area.	Estimated discharge at Geddes.	Remarks.
		Sec.-feet.	*Sq. miles.*	*Sec.-feet.*	
Hudson	Jan. 27	369	520	337	
Scio	Feb. 5	367	683	407	Thaw on Feb. 6.
Hudson	Feb. 17	347	520	505	
Ann Arbor	Feb. 22	540	724	564	Thawing Feb. 28, 29.
Geddes	Feb. 26	505	757	505	Do.
Do	Mar. 2	730	757	730	River rising.
Peninsular and Dubel.	Mar. 3	1,300	795	1,238	Some uncertainty.
Waterworks	Mar. 4	1,800	801	1,626	Freeze-up.
Below waterworks	Mar. 8	3,100	801	3,200	Relative stage.
Do	Mar. 9	3,100	801	3,200	Unchanging.
Do	Mar. 10	3,100	801	3,200	Freezing Mar. 12–17.

A portion of the drainage basin is shown on the Ann Arbor sheet of the United States Geological Survey Typographic Atlas. The drainage areas have been deduced from this and other recent maps. The area above Ann Arbor has formerly been given as 841 square miles.

The discharge at Rawsonville, Mich., was measured by surface floats by Edgar Williams, C. E., October 10, 1904, and was 310 second-feet. The maximum discharge in the flood of March, 1904, deduced from a profile of the Geddes dam by L. E. Cooley was 4,700 second-feet.

HURON RIVER AT DOVER, MICH.

A gage was erected at the highway bridge at Dover, August 7, 1904. The conditions are not suitable for the use of current meter at the highway bridge. The stream above this point is unregulated, and the fluctuations in gage heights show its natural variation. The gage is read and the record furnished by F. Burkett. A current-meter measurement by W. M. Gregory, made by wading near the gage August 4, 1904, showed a discharge of 116 second-feet.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily gage height, in feet, of Huron River at Dover, Mich., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.[b]	Day	Aug.	Sept.	Oct.	Nov.	Dec.[b]
1	.....	1.20	2.25	1.90	1.70	17	.25	1.20	2.20	1.80	1.50
2	.....	1.10	2.25	1.90	1.70	18	.25	1.20	2.15	1.80	1.45
3	.....	1.05	2.20	1.85	1.70	19	.28	1.20	2.15	1.80	1.45
4	.....	1.00	2.20	1.85	1.70	20	.52	1.20	2.15	1.80	1.45
5	.....	.90	2.15	1.80	1.65	21	.75	1.20	2.10	1.80	1.50
6	.....	.70	2.12	1.80	1.65	22	.92	1.25	2.10	1.80	1.50
7	0.25	.60	2.10	1.80	1.65	23	1.05	1.28	2.05	1.75	1.60
8	.22	.60	2.15	1.80	1.65	24	1.20	1.30	2.00	1.75	1.65
9	.20	.90	(a)	1.80	1.65	25	1.25	1.70	2.00	1.75	1.70
10	.20	1.20	.....	1.80	1.60	26	1.25	1.95	2.00	1.75	1.70
11	.20	1.20	.....	1.80	1.60	27	1.20	2.00	2.00	1.70	1.80
12	.25	1.20	.....	1.80	1.60	28	1.18	2.10	1.95	1.70	1.90
13	.25	1.20	.....	1.80	1.55	29	1.20	2.12	1.95	1.70	1.90
14	.25	1.15	.....	1.80	1.55	30	1.20	2.20	1.95	1.70	2.00
15	.25	1.15	.....	1.80	1.55	31	1.25	.....	1.95	.....	2.10
16	.25	1.20	2.20	1.80	1.55						

[a] No record. [b] Probable ice conditions during December.

HURON RIVER AT DEXTER, MICH.

A vertical gage scale, divided decimally, was erected for use during low water just above the highway bridge in the village of Dexter, September 1, 1904. The record has been maintained by the Washtenaw Electric Company, and has been furnished by R. W. Hemphill, manager. A boat and cable section was selected a short distance below the highway bridge, and current-meter measurements have been made, as indicated in the accompanying table. The gage is located just above a rapid, where it will be less affected by freezing than elsewhere.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Huron River at Dexter, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 30	Horton and Beebe	282	0.67	1.10	189
September 21	H. R. Beebe	274	.76	1.14	208
October 6	Edgar Williams	.....	.....	1.37	[a] 278
December 19	C. C. Covert	279	.86	1.10	241

[a] Velocity determined by floats.

Mean daily gage height, in feet, of Huron River at Dexter, Mich., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	1.30	1.38	1.18	1.05	17	1.05	1.35	1.15	1.35
2	1.40	1.35	1.15	1.05	18	1.10	1.35	1.15	1.30
3	1.25	1.28	1.15	1.05	19	1.10	1.35	1.15	1.25
4	1.10	1.30	1.15	1.10	20	1.10	1.30	1.15	1.25
5	1.25	1.30	1.15	1.15	21	1.05	1.30	1.15	1.25
6	1.15	1.35	1.15	1.15	22	1.02	1.28	1.15	1.25
7	1.10	1.30	1.15	1.15	23	1.05	1.25	1.15	1.10
8	1.10	1.30	1.15	1.10	24	1.02	1.25	1.15	1.10
9	1.10	1.30	1.15	1.10	25	1.12	1.25	1.15	1.25
10	1.15	1.30	1.15	1.10	26	1.30	1.25	1.15	1.35
11	1.08	1.40	1.15	1.10	27	1.60	1.20	1.10	1.30
12	1.10	1.40	1.15	1.10	28	1.68	1.20	1.10	1.35
13	1.08	1.42	1.15	1.25	29	1.55	1.20	1.10	1.40
14	1.02	1.40	1.15	1.30	30	1.40	1.20	1.10	1.35
15	1.02	1.35	1.15	1.40	31	.....	1.20	.....	1.30
16	1.05	1.35	1.15	1.30					

HURON RIVER AT GEDDES, MICH.

A record of the depth of overflow at the dam and of the run of the water wheels in the adjacent electric plant was maintained at Geddes by the Washtenaw Electric Company, beginning February 1, 1904. This record has been compiled and the discharge computed by L. E. Cooley, and a copy of the results furnished. A survey of the dam was made by R. E. Horton for the United States Geological Survey in September, 1904. New gages were erected and the record has been maintained and furnished to the Survey from that date. The crest of the dam was changed in September, 1904, and the additional data necessary for computation of the discharge to the end of the year have not been obtained. This gaging station affords opportunity to determine the discharge during low water both in summer and winter. At times, when water flows over the dam, the discharge is less certain.

Mean daily discharge, in second-feet, of Huron River at Geddes, Mich., for 1904.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	a 465	a 600	3,602	791	617	219	117	288	307	248
2	a 450	730	3,066	923	559	210	111	325	307	238
3	a 435	1,238	3,254	754	589	396	117	271	288	238
4	a 420	1,636	3,000	739	652	337	118	222	288	238
5	407	a 2,000	2,761	819	543	184	135	271	288	238
6	a 410	a 2,600	2,412	804	521	176	136	238	307	238
7	a 590	a 3,000	2,226	763	514	193	97	238	288	238
8	a 700	3,200	2,221	684	413	197	125	222	288	238
9	676	3,200	2,211	466	343	199	128	222	288	238
10	a 600	3,200	2,285	505	300	278	119	238	288	238
11	a 560	a 3,160	2,081	589	315	218	101	216	325	238
12	a 540	a 2,960	1,977	601	438	196	153	222	325	238
13	a 530	a 2,500	1,610	541	357	189	147	216	332	238
14	a 520	a 2,100	1,309	438	241	186	155	197	325	238
15	a 515	a 1,700	1,134	450	227	154	132	197	307	238
16	a 510	a 1,300	1,245	440	217	136	130	191	307	238
17	505	a 1,000	1,278	448	171	113	126	191	307	238
18	a 503	1,089	1,228	494	198	146	127	222	307	238
19	a 501	1,312	1,257	410	167	153	164	222	307	238
20	a 500	1,602	1,198	617	156	119	335	222	288	.....
21	a 530	1,502	1,166	952	148	122	304	206	288	.....
22	564	2,642	1,123	1,006	157	98	292	197	296	.....
23	a 600	2,965	1,131	745	157	107	245	206	271	.....
24	a 560	2,673	877	811	138	92	260	197	271	.....
25	a 520	3,535	815	713	162	105	258	228	271	.....
26	505	3,519	981	633	347	134	233	288	271	.....
27	a 500	3,090	819	616	518	132	235	403	254	.....
28	a 536	3,720	782	707	396	124	269	436	254	.....
29	a 570	3,734	749	749	212	118	254	383	254	.....
30	.....	3,409	722	487	233	102	213	325	254	.....
31	.....	3,096	.....	649	.....	106	a 254	.....	254	.....

a Interpolated.

Estimated monthly discharge of Huron River at Geddes, Mich., for 1904.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
February	700	407	525
March	3,734	600	2,387
April	3,602	722	1,684
May	1,006	410	656
June	652	138	334
July	396	92	169
August	335	97	180
September	436	191	250
October	332	254	290
November 1–19	248	238	239

HURON RIVER AT FRENCH LANDING, MICH.

A temporary gage was erected at the Wabash Railroad bridge at Frenchville, and maintained for a few weeks during the low-water season of 1903. A new gage was erected August 5, 1904, at the highway bridge at French Landing. This gage consists of a vertical scale divided decimally attached to the downstream side of the right-hand bridge abutment. The gage is read twice each day by F. L. Robbe. The record is furnished by the Washtenaw Electric Company, of Ann Arbor, Mich. The stream freezes over in winter, and when frozen the conditions are unfavorable for the determination of the discharge. The right-hand bank is never overflowed. The highway may be overflowed for a short distance from the bridge during extreme freshets.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Huron River at French Landing, Mich., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 16	W. M. Gregory	455	1.50	[a] 1.70	685
September 18	do	500	1.64	[a] 2.20	824
1904.					
May 24	R. E. Horton	516	1.51	[a] 2.00	781
August 2	W. M. Gregory	322	.61	[b] .88	197
August 31	Horton and Beebe	305	.88	[b] 1.49	269
September 23	H. R. Beebe	352	.96	[b] 1.80	337
September 23	do	371	1.04	[b] 1.98	387

[a] Board gage at Wabash Railroad bridge.
[b] Permanent gage at highway bridge from which measurements are made.

Mean daily gage height, in feet, of Huron River at French Landing, Mich., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.[a]	Day.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	.....	1.28	2.60	1.75	1.18	17	1.10	1.20	1.85	1.22	1.08
2	.....	1.58	1.95	1.75	1.20	18	1.12	.88	2.15	1.25	1.22
3	.....	1.78	1.85	1.50	1.52	19	1.22	1.38	1.65	1.22	1.48
4	.....	1.58	2.10	1.32	1.28	20	1.37	1.22	1.78	1.12	2.10
5	1.27	1.42	1.78	1.30	1.00	21	.87	1.28	1.85	1.28	1.48
6	1.10	1.45	1.75	1.28	1.85	22	1.54	1.68	1.85	1.68	1.48
7	.80	1.88	1.75	1.10	1.38	23	1.72	1.80	1.58	1.32	1.48
8	.42	1.42	1.72	1.58	1.08	24	1.50	1.72	1.52	1.28	1.68
9	.60	1.20	1.90	1.42	1.05	25	1.47	1.60	1.92	1.28	1.58
10	1.27	.55	1.65	1.15	1.22	26	1.44	2.32	1.70	1.25	1.50
11	1.24	—.70	2.05	1.22	1.15	27	1.27	3.00	1.58	1.18	2.55
12	1.10	.30	2.10	1.28	1.10	28	1.10	3.12	1.68	1.35	2.55
13	.97	1.90	1.55	1.15	1.55	29	1.30	2.85	1.65	1.82	1.55
14	.67	1.38	1.88	1.00	1.45	30	1.44	2.68	1.60	1.28	1.80
15	.22	1.15	2.05	1.70	1.42	31	1.49	.....	1.22	.....	2.40
16	1.22	1.18	1.62	1.35	1.35						

[a] Ice conditions during December.

HURON RIVER AT FLATROCK, MICH.

A gage was erected on August 6, 1904, at the highway bridge below Metler's dam at Flatrock. The gage is a vertical scale, divided decimally, attached to the downstream side of the left-hand bridge abutment. The stream bed is of horizontal rock overlaid with sand and gravel. The current, aside from slight eddies and swirls carried by the water from the dam and mill above, is comparatively smooth and uniform. The gage is read twice each day by C. L. Metler.

The stream freezes over but little in winter, owing to the close proximity to the dam above, and the banks are smooth and are only overflowed in highest freshets, occurring at rare intervals, such as, for example, the flood of March 26, 1904, which overflowed the banks on the right-hand side of the bridge. Flatrock is located about 8 miles above the mouth of the stream.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Huron River at Flatrock, Mich., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 1	W. M. Gregory	79	1.21	0.30	95
August 6	do	144	1.43	.98	208
September 1	Horton and Beebe	168	1.63	1.29	274
September 23	H. R. Beebe	177	1.68	1.35	298
December 20	C. C. Covert	159	1.30	1.20	209

Mean daily gage height, in feet, of Huron River at Flatrock, Mich., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.30	2.10	1.40	1.30	17	1.05	1.10	1.40	1.35	1.25
2	.....	1.35	1.70	1.60	1.30	18	.95	1.10	1.85	1.35	1.45
3	.....	1.80	1.80	1.30	1.15	19	.95	1.10	1.75	1.35	1.40
4	.....	1.60	1.85	1.40	1.40	20	1.19	1.10	1.75	1.30	1.30
5	.....	1.40	1.65	1.30	1.35	21	1.01	1.20	1.75	1.40	1.60
6	0.95	1.30	1.60	1.40	1.60	22	1.12	1.12	1.75	1.60	1.35
7	.85	1.50	1.65	1.25	1.55	23	1.60	1.55	1.60	1.40	1.55
8	.45	1.65	1.70	1.65	1.30	24	1.40	1.40	1.35	1.30	1.60
9	.34	1.30	1.75	1.45	1.35	25	1.15	1.55	1.65	1.30	1.35
10	.59	1.20	1.70	1.35	1.40	26	1.20	1.90	1.55	1.40	1.15
11	.88	1.28	1.80	1.40	1.30	27	1.25	2.65	1.45	1.40	1.85
12	.82	1.10	1.90	1.45	1.25	28	1.10	2.65	1.45	1.35	2.50
13	.90	1.22	1.80	1.40	1.15	29	.95	2.62	1.45	1.50	2.10
14	.82	.....	1.45	1.30	1.75	30	1.40	2.55	1.45	1.35	2.00
15	.46	1.25	1.95	1.40	1.25	31	1.35	.....	1.35	.....	1.85
16	.26	1.25	1.80	1.40	1.40						

MAUMEE RIVER NEAR SHERWOOD, OHIO.

This station was established May 19, 1903, by R. Winthrop Pratt. It is located at the highway bridge 2½ miles south of Sherwood, Ohio, and 200 feet upstream from the Cincinnati and Northern Railroad bridge. The inclined gage which was established on the bank under the north end of the bridge was destroyed. A regulation chain gage was installed in June, 1903. This is bolted to the hand rail of the bridge on the upstream side, 200 feet from the south abutment. The length of the chain from the end of the weight to the marker is 28.88 feet. The channel is straight for 1,000 feet above and 500 feet below the bridge. Both banks are high and clean, and both may overflow at extreme high water. A high-water gage is painted on the bridge abutment at the north end of the bridge. The observer is George J. Coffin. Discharge measurements are made from the two-span highway bridge, which has a total length of 300 feet between abutments. The initial point for soundings is the face of the south abutment.

The following bench marks have been established: (1) A copper bolt in the stepping stone of the west wing wall of the north abutment (stone is in tier just below the top tier). It is 22.30 feet above the zero of the gage. (2) A cut in the iron hand rail directly over the pulley of the gage. Its elevation is 29.69 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Maumee River near Sherwood, Ohio, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 12[a]	R. W. Pratt	284	5,112	2.45	18.30	12,520
March 31	do	282	4,973	3.42	18.50	17,000
May 11	do	245	787	1.06	3.34	832
May 31	do	250	1,022	1.54	4.34	1,572
August 18[b]	do	139	212	.61	1.98	130
September 27	do	244	506	.39	2.20	199
October 13	do	244	527	.49	2.28	258
December 3[b]	do	156	170	.64	1.83	109

[a] Partially frozen. Velocity partially estimated. Backwater due to ice gorge below.
[b] Wading at different section.

Mean daily gage height, in feet, of Maumee River near Sherwood, Ohio, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.50	16.00	20.60	18.80	6.70	4.70	2.80	2.30	2.40	2.40	2.00	1.85
2	3.40	18.00	21.30	18.50	5.80	5.20	2.80	2.30	2.40	2.45	2.00	1.85
3	3.20	11.00	21.80	18.00	5.00	4.90	2.70	2.30	2.30	2.40	2.00	1.85
4	3.00	10.50	21.60	18.00	4.70	4.70	2.60	2.40	2.30	2.30	2.00	1.85
5	2.70	10.20	21.00	18.10	4.20	4.30	2.60	2.40	2.20	2.30	2.00	1.85
6	2.70	10.70	21.00	17.50	3.90	4.00	2.70	2.40	2.20	2.20	2.00	1.80
7	2.70	12.50	20.40	14.80	3.60	3.80	2.90	2.30	2.20	2.20	2.00	1.80
8	2.70	17.50	20.90	9.60	3.30	3.60	5.10	2.30	2.20	2.15	1.95	1.80
9	2.70	18.50	20.30	8.60	3.40	3.40	7.60	2.20	2.20	2.30	1.95	1.80
10	2.70	19.30	19.30	8.50	3.40	3.20	7.70	2.20	2.20	2.40	1.95	1.80
11	2.70	19.50	16.40	8.40	3.40	3.00	7.90	2.20	2.20	2.30	1.95	1.85
12	2.70	18.30	12.20	8.00	3.20	2.90	8.10	2.20	2.10	2.30	1.95	1.90
13	2.70	17.40	10.30	7.50	3.10	2.80	7.50	2.20	2.10	2.25	1.90	1.90
14	2.70	16.30	9.60	7.00	3.10	2.70	6.60	2.10	2.10	2.20	1.90	1.90
15	2.70	14.70	8.50	6.40	3.10	2.60	5.90	2.10	2.05	2.20	1.85	2.00
16	2.70	12.30	7.20	5.80	3.00	2.60	4.60	2.10	2.05	2.20	1.85	2.00
17	2.70	11.50	7.20	5.30	3.00	2.50	3.60	2.10	2.05	2.20	1.85	2.00
18	2.70	10.50	6.50	4.90	3.00	2.50	3.20	2.00	2.05	2.20	1.85	2.00
19	2.70	9.80	8.60	4.60	3.00	2.50	2.90	2.00	2.10	2.20	1.85	2.00
20	2.70	9.30	11.70	4.30	3.00	2.50	2.70	2.20	2.30	2.20	1.85	2.00
21	6.60	8.70	11.70	4.00	3.20	2.50	2.60	2.30	2.20	2.15	1.85	2.00
22	[a]19.00	8.30	12.80	3.90	3.40	2.50	2.60	2.40	2.20	2.15	1.85	2.00
23	22.50	8.40	14.20	3.70	3.50	2.70	2.50	3.40	2.20	2.15	1.85	2.00
24	22.75	8.70	14.00	4.20	3.50	3.00	2.50	3.30	2.20	2.10	1.85	2.00
25	20.25	11.00	14.30	4.40	3.40	3.10	2.50	2.90	2.20	2.00	1.85	2.00
26	19.25	11.50	18.50	10.20	3.40	3.20	2.40	2.80	2.20	2.00	1.85	2.00
27	18.50	11.30	19.85	12.90	3.50	3.20	2.30	2.60	2.20	2.00	1.85	2.35
28	18.00	10.10	19.65	11.90	3.40	3.10	2.30	2.60	2.20	2.00	1.85	2.50
29	17.50	11.30	19.15	9.80	3.40	3.00	2.30	2.50	2.30	2.00	1.85	3.65
30	17.00	.....	18.30	7.90	3.80	2.80	2.30	2.40	2.40	2.00	1.85	4.00
31	16.50	.....	18.60	.....	4.20	.....	2.30	2.40	.....	2.00	.....	4.00

[a] Backwater caused by ice gorge.

NOTE.—Ice conditions January 1 to March 11, and during December.

Rating table for Maumee River near Sherwood, Ohio, from May 19, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	80	3.50	995	5.40	2,390	10.00	6,370
1.90	110	3.60	1,065	5.60	2,550	10.50	6,870
2.00	145	3.70	1,135	5.80	2,710	11.00	7,370
2.10	185	3.80	1,205	6.00	2,870	11.50	7,920
2.20	230	3.90	1,275	6.20	3,030	12.00	8,470
2.30	280	4.00	1,345	6.40	3,190	12.50	9,020
2.40	330	4.10	1,415	6.60	3,350	13.00	9,580
2.50	380	4.20	1,485	6.80	3,510	13.50	10,180
2.60	440	4.30	1,555	7.00	3,670	14.00	10,780
2.70	500	4.40	1,625	7.20	3,830	14.50	11,430
2.80	560	4.50	1,695	7.40	3,990	15.00	12,080
2.90	620	4.60	1,765	7.60	4,170	15.50	12,730
3.00	680	4.70	1,835	7.80	4,350	16.00	13,380
3.10	740	4.80	1,910	8.00	4,530	16.50	14,080
3.20	800	4.90	1,990	8.50	4,980	17.00	14,780
3.30	860	5.00	2,070	9.00	5,430	18.00	16,280
3.40	925	5.20	2,230	9.50	5,880	19.00	17,780

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.80 feet and 6.20 feet. Above 6.20 feet the rating curve is determined by one high-water measurement. Above gage height 17.00 feet the rating curve is a tangent, the difference being 150 per tenth.

Estimated monthly discharge of Maumee River near Sherwood, Ohio, for 1903 and 1904.

[Drainage area, 2,190 square miles.]

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent of rainfall.	
1903.							
January							1.65
February							3.91
March							1.91
April							5.02
May 20–31	1,205	230	756	0.345	0.154		3.15
June	4,980	230	1,313	.600	.669	19	3.56
July[a]	620	110	287	.131	.151	3	4.56
August[a]	380	185	255	.116	.134	3	4.45
September	1,695	280	689	.315	.351	18	1.99
October	440	185	287	.131	.151	6	2.56
November	380	185	261	.119	.133	8	1.70
December 1–10[b]	230	230	230	.105	.039		2.42

[a] Discharge July 21 to August 4 interpolated. [b] River frozen December 11 to 31.

Estimated monthly discharge of Maumee River near Sherwood, Ohio, etc.—Continued.

Month.	Discharge in second-feet.			Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Per cent of rainfall.	
1904.							
January							4.55
February							3.33
March 12–31	19,130	3,270	10,400	4.75	3.53		6.39
April	17,480	1,135	6,648	3.04	3.39	95	3.58
May	3,430	680	1,130	.516	.595	18	3.28
June	2,230	380	860	.393	.438	20	2.18
July	4,620	280	1,354	.618	.712	19	3.74
August	860	145	313	.143	.165	5	3.42
September	330	165	232	.106	.118	4	3.14
October	355	145	229	.105	.121	6	1.87
November	145	95	113	.052	.058	40	.14
December							

NOTE.—River frozen during omitted periods 1904.

TIFFIN RIVER NEAR DEFIANCE, OHIO.

This station was established May 19, 1903, by R. Winthrop Pratt. It is located at the highway bridge on the new road to Evansport, one-half mile above the settlement of Brunnesburg, and 3 miles by river above the center of the city of Defiance, Ohio. A standard chain gage is located on the upstream handrail of the bridge, about 100 feet from the initial point for soundings. The length of the chain from the end of the weight to the marker is 28.00 feet. The gage is read once each day by F. A. Goddard. Discharge measurements are made from the single-span highway bridge 140 feet long between abutments. The initial point for soundings is the face of the south abutment. The channel is somewhat curved, but the section is at right angles to the direction of the current. The velocity is sluggish at low stages at the regular section, but can be measured by wading a short distance below the bridge. The bed of the stream is composed of gravel and rock, with deposits of silt at the sides of the channel. Both banks are high; the right bank is not liable to overflow, but the left will overflow at extreme high stages on account of a low place in the road. The bench mark is a cut on the upstream corner of the north abutment. Its elevation is 23.82 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Tiffin River near Defiance, Ohio, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 12 [a]	R. W. Pratt	128	1,341	2.01	11.80	2,700
March 31	do	130	1,639	2.67	14.00	4,378
May 11	do	99	335	.71	3.44	238
August 18 [b]	do	45	74	.49	2.40	36
September 27	do	90	234	.21	2.52	50
October 13	do	91	242	.25	2.60	61
December 3 [b]	do	42	36	.78	2.32	28

[a] Ice. [b] Wading at different section.

Mean daily gage height, in feet, of Tiffin River near Defiance, Ohio, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.50	6.30	20.50	16.20	5.40	5.50	2.50	3.00	2.50	2.90	2.50	2.40
2	3.40	6.20	20.80	17.20	4.50	5.00	2.50	2.70	2.50	.....	2.50	2.35
3	.....	6.70	17.40	17.50	4.10	4.70	.....	2.70	2.50	3.15	2.45	2.30
4	3.30	6.30	15.40	15.30	3.90	4.30	2.50	2.50	.....	3.10	2.50	.....
5	3.20	6.00	14.05	13.50	3.60	.....	2.50	2.50	2.50	2.70	2.50	.....
6	3.10	6.60	.....	10.20	3.50	3.90	2.50	2.40	2.40	2.55	.....	.....
7	3.10	.....	13.30	9.20	3.40	3.70	3.00	.....	2.40	2.50	2.40	.....
8	3.10	12.80	13.90	7.20	.....	3.50	4.50	2.40	2.40	2.50	2.40	.....
9	3.10	14.00	12.80	7.00	3.20	3.20	6.40	2.40	2.40	.....	2.40	.....
10	.....	13.80	12.00	8.00	3.20	3.10	.....	2.30	2.40	2.50	2.50	.....
11	3.10	12.60	11.60	7.50	3.30	2.90	6.30	2.30	.....	2.55	2.50	.....
12	3.10	11.80	11.20	7.20	3.30	.....	5.60	2.40	2.40	2.60	2.50	[b]2.50
13	3.10	11.05	.....	6.90	3.40	2.80	4.70	2.40	2.40	2.60	.....	.....
14	3.10	.....	9.00	6.30	3.30	2.70	4.00	.....	2.40	2.60	2.40	.....
15	3.10	8.80	7.70	5.70	.....	2.60	3.60	2.60	2.40	2.60	2.40	.....
16	3.10	7.60	6.70	5.40	3.20	2.60	3.00	2.40	2.40	.....	2.40	.....
17	3.10	6.50	6.10	.....	3.10	2.50	.....	2.60	2.40	2.65	2.40	2.35
18	3.10	5.70	5.70	4.60	3.10	2.50	2.60	2.40	.....	2.60	2.40	.....
19	3.10	5.50	6.30	4.60	3.10	.....	2.50	2.40	2.40	2.50	2.40	.....
20	4.60	5.00	9.00	4.40	3.50	2.50	2.70	2.55	2.40	2.50	.....	.....
21	12.00	.....	11.20	4.20	3.80	2.60	2.70	.....	2.40	2.40	2.40	.....
22	17.10	4.90	12.50	4.10	.....	2.60	2.90	4.20	2.40	2.50	2.40	.....
23	17.80	4.90	13.50	4.00	3.90	2.60	2.70	3.70	2.40	.....	2.40	.....
24	.....	5.60	13.10	.....	3.80	2.60	.....	3.50	2.40	2.45	2.40	2.50
25	14.70	5.70	13.00	4.50	3.60	2.60	2.50	3.10	.....	2.45	2.40	.....
26	13.70	6.00	17.60	6.50	3.20	.....	2.50	3.00	2.50	2.45	2.40	2.70
27	12.50	5.60	19.50	8.50	3.10	2.50	2.40	2.85	2.50	2.50	.....	2.90
28	10.90	.....	18.00	7.00	3.00	2.60	2.40	.....	2.70	2.50	2.40	4.80
29	9.20	13.30	15.00	6.40	3.00	2.50	2.50	2.80	3.10	2.50	2.40	4.55
30	8.40	.....	12.70	5.70	3.10	2.50	2.50	2.70	3.20	.....	2.40	4.60
31	.....	.....	14.00	.....	5.30	.....	.....	2.60	.....	2.50	.....	4.15

[a] Ice conditions January 1 to March 10. [b] River frozen December 12 to 31.

NOTE.—During frozen period gage read to water surface.

Rating table for Tiffin River near Defiance, Ohio, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	24	4.10	484	5.80	1,034	9.00	2,200
2.40	33	4.20	515	5.90	1,068	9.50	2,400
2.50	46	4.30	546	6.00	1,102	10.00	2,600
2.60	64	4.40	578	6.20	1,172	10.50	2,811
2.70	88	4.50	610	6.40	1,242	11.00	3,035
2.80	114	4.60	642	6.60	1,312	11.50	3,260
2.90	140	4.70	674	6.80	1,382	12.00	3,485
3.00	167	4.80	706	7.00	1,454	12.50	3,710
3.10	194	4.90	738	7.20	1,526	13.00	3,935
3.20	221	5.00	770	7.40	1,598	13.50	4,160
3.30	249	5.10	803	7.60	1,670	14.00	4,385
3.40	277	5.20	836	7.80	1,742	15.00	4,835
3.50	306	5.30	869	8.00	1,814	16.00	5,285
3.60	335	5.40	902	8.20	1,890	17.00	5,735
3.70	364	5.50	935	8.40	1,966	18.00	6,185
3.80	393	5.60	968	8.60	2,044	19.00	6,635
3.90	423	5.70	1,001	8.80	2,122	20.00	7,085
4.00	453						

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 2.3 feet and 3.1 feet, and poorly defined above. A single high-water measurement at gage height 14.0 feet determines the upper part of the curve. Above gage height 10.6 feet the rating curve is a tangent, the difference being 45 per tenth.

Estimated monthly discharge of Tiffin River near Defiance, Ohio, for 1904.

[Drainage area, 748 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 11–31	6,860	1,001	3,730	4.99	3.90
April	5,960	453	1,865	2.49	2.78
May	902	167	328	.439	.506
June	935	46	209	.279	.311
July	1,242	33	270	.361	.416
August	515	24	109	.146	.168
September	221	33	49.7	.066	.074
October	208	33	68.6	.092	.105
November	46	33	36.7	.049	.055

NOTE.—Discharge interpolated for missing days. River frozen January 1 to March 10, also during December.

BLACK RIVER NEAR ELYRIA, OHIO.

This station was established May 23, 1903, by R. Winthrop Pratt, the object being to furnish data for the water supply of near-by towns. The station is located at the Niel Avenue Bridge, about 5 miles from the center of the city of Elyria, Ohio. The original gage consisted of an inclined 1 by 6 inch board set on edge in the bank and secured to long stakes, and a vertical section nailed to stakes driven in the ground. The inclined section reads from zero to 5 feet and the vertical section from 5 to 12 feet. A regulation chain gage has been installed to replace the rod gage first established. The length from the end of the weight to the marker is 24.67 feet. The gage is read once each day by N. L. Durfee. Discharge measurements are made from the single-span highway bridge. The initial point for soundings is the face of the west abutment. The bed of the stream is a rock ledge, and there is but one channel. The current is sluggish at low stages at the regular section, but may be measured by wading 500 feet below. The channel is straight for 300 feet above and 200 feet below the bridge. The right bank is fairly high, and overflows only in extreme floods. When this occurs a large adjacent field is generally flooded. The left bank is a high, rocky bluff, from 75 to 100 feet in height, which can not overflow.

The following bench marks have been established: (1) A wire nail in the root of a double tree which is in line with the center of and 38 feet west from the west end of the bridge. Its elevation is 28.74 feet above gage datum. (2) The top of the flange of the fifth floor beam from the west abutment on the downstream end (almost under the pulley of the gage). Its elevation is 22.56 feet above gage datum. The elevation of the center of the pulley is 24.67 feet above gage datum. The drainage area at this station is 417 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Black River near Elyria, Ohio, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 9	R. W. Pratt	79	188	3.68	3.55	691
May 17	do	63	66	1.03	1.70	[a] 68
June 22	do	35	20	.59	1.15	12
June 22	do	35	19	.58	1.15	11.4
July 6	do	80	246	3.63	4.11	894
July 28	do	41	24	1.04	1.28	25
August 11	do	34	14	.59	1.05	8.2
October 4	do	35	17	.60	1.14	10.5
November 4	do	33	13	.22	.96	2.8

[a] Channel changed.

Mean daily gage height, in feet, of Black River near Elyria, Ohio, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.00	2.80	13.60	12.20	4.50	8.70	1.00	1.00	1.30	1.10	1.00	1.40
2	1.90	2.70	6.50	13.40	3.70	8.10	1.00	1.10	1.30	1.20	1.00	1.30
3	1.90	2.60	8.90	7.80	2.60	5.10	1.40	1.10	1.20	1.15	1.05	1.20
4	1.80	2.90	9.40	3.70	2.10	3.20	1.40	1.00	1.10	1.10	1.05	1.20
5	1.80	4.20	5.90	2.50	1.60	2.70	1.90	1.00	1.10	1.10	1.00	1.20
6	1.80	2.70	4.70	2.40	1.20	2.60	4.20	1.00	1.10	1.05	.90	1.10
7	1.70	12.20	4.40	2.20	1.10	2.60	8.70	.90	1.00	1.00	.90	1.00
8	1.70	10.60	4.10	2.10	1.00	2.40	5.90	.90	1.00	1.00	.90	1.10
9	1.60	8.20	3.50	2.10	1.00	1.90	3.40	1.00	1.00	.90	1.00	1.60
10	1.60	5.10	2.90	2.50	1.50	1.70	2.30	1.00	1.00	.90	1.00	1.60
11	1.50	4.90	2.40	2.40	1.50	1.50	2.40	1.20	.90	1.01	1.00	1.50
12	1.50	3.90	2.40	3.10	1.40	1.50	2.40	1.70	1.10	1.02	1.60	1.50
13	1.40	3.90	2.30	2.50	1.40	1.40	1.90	1.80	1.10	1.15	1.50	1.60
14	1.40	3.80	2.20	2.80	1.40	1.40	1.60	1.70	1.20	1.15	1.50	1.50
15	1.30	2.60	2.00	2.20	1.60	1.30	1.40	1.70	1.25	1.01	1.40	1.40
16	1.30	2.50	1.90	2.10	1.60	1.30	1.30	1.60	1.20	1.01	1.40	1.40
17	1.50	2.30	1.50	2.00	1.50	1.40	1.30	1.60	1.20	1.02	1.60	1.50
18	1.30	2.20	4.10	1.90	1.90	1.30	1.20	1.60	1.15	1.02	1.70	1.40
19	1.50	2.20	5.20	1.90	2.10	1.20	1.20	1.80	1.15	1.15	1.80	a1.40
20	2.90	2.10	3.90	1.80	2.10	1.20	1.10	1.90	1.15	1.15	1.80	1.50
21	11.50	2.20	3.90	1.50	1.80	1.30	1.70	1.90	1.10	1.05	1.70	1.50
22	18.50	3.20	3.50	1.30	1.60	1.20	1.80	1.80	1.05	1.00	1.60	1.40
23	15.60	3.90	3.40	1.20	1.40	1.20	1.70	1.80	.90	1.00	1.60	1.40
24	10.50	3.50	4.50	1.20	1.90	1.20	1.60	1.70	.90	1.03	1.70	1.40
25	6.10	3.30	4.00	2.20	1.70	1.10	1.50	1.70	.95	1.03	1.80	1.45
26	4.50	3.10	11.90	3.10	2.00	1.10	1.40	1.50	1.20	1.02	1.90	1.60
27	2.80	2.60	12.20	4.50	2.10	1.00	1.30	1.40	1.05	1.02	1.90	2.50
28	3.40	2.40	7.50	4.10	2.00	1.10	1.20	1.40	.90	1.01	1.85	2.60
29	3.20	7.60	4.60	4.50	2.00	1.10	1.10	1.30	.90	1.01	1.80	2.50
30	3.00	.....	2.40	4.40	2.70	1.10	1.10	1.20	.90	1.05	1.70	2.30
31	2.80	.....	4.80	.....	5.80	.....	1.00	1.20	.....	1.05	.....	2.40

a Ice conditions January, February, and March, and also December 19 to 31.

CUYAHOGA RIVER AT INDEPENDENCE, OHIO.

This station is located on a single-span highway bridge at the town of Independence, 10 miles south of Cleveland, Ohio, and 4 miles south of the gaging station formerly located on the highway bridge between Brooklyn and Newburg. It was established at this point September 21, 1903. The observer is W. H. Rupp. The initial point for soundings is the face of the eastern abutment. The gage is a regulation chain gage bolted to the hand rail of the bridge on the downstream side, 100 feet west of the initial point. The length from the end of the weight to the back of the ring is 26.84 feet. The conditions at this point are generally favorable, though the current at low water is sluggish, and in the center there is the remains of an old pier used in the support of a former two-span bridge.

The following bench marks have been established: (1) A cross cut on the northeast corner of the top stone of the northerly wing wall of the west abutment; elevation, 23.65 feet above gage datum. (2) A cross

cut on the southwest corner of the top stone of the southerly wing wall: elevation, 22.58 feet above gage datum. (3) The top of the inside eyebeam of the lower chord, downstream side, at a point 100 feet west of the initial point; elevation, 23.95 feet above gage datum. Elevation of the center of the pulley is 26.18 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Cuyahoga River at Independence, Ohio, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per. sec.*	*Feet.*	*Second-feet.*
March 7	R. W. Pratt	102	1,183	4.41	14.65	5,230
April 15	do	78	397	2.40	7.05	[a]952
May 18	do	70	286	1.15	5.63	[b]330
June 25	do	68	293	1.33	5.52	390
July 27	do	71	268	1.27	5.45	341
August 11	do	76	276	1.52	5.61	420
September 16	do	62	229	.42	4.98	95
October 5	do	62	239	.52	5.10	[c]125
November 5	do	62	244	.39	5.00	[d]91
December 7	do	64	262	.57	5.15	150

[a] No flow in canal. [b] Canal, 32 second-feet. [c] Canal, 78 second-feet. [d] Canal, 67 second-feet.

Mean daily gage height, in feet, of Cuyahoga River at Independence, Ohio, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.70	11.70	17.00	16.30	8.70	11.20	5.30	5.50	5.10	4.95	5.10	5.05
2	5.70	10.70	17.00	15.10	8.40	14.80	6.60	6.70	5.10	4.90	5.05	5.10
3	5.60	10.70	17.00	13.40	8.00	13.80	.....	5.60	5.10	4.90	5.00	4.75
4	5.50	10.00	17.00	11.50	7.40	12.00	.....	5.30	5.10	5.10	5.15	4.70
5	6.50	9.70	17.00	10.10	7.00	10.40	.....	5.20	5.10	5.10	5.00	4.75
6	5.40	9.70	14.00	9.10	6.50	8.90	.....	5.10	5.05	5.05	5.05	5.00
7	5.40	12.00	14.00	8.20	6.20	7.90	.....	5.10	5.20	5.00	4.90	5.15
8	5.50	12.00	10.40	8.70	6.10	7.00	.....	4.90	5.00	5.10	5.10	[a]5.00
9	5.50	12.00	9.90	8.30	6.00	6.50	.....	5.10	5.00	5.10	5.05	5.10
10	5.40	12.00	9.50	7.90	6.00	6.50	.....	5.10	5.00	5.00	5.05	5.00
11	5.40	12.00	8.60	7.90	5.90	5.90	.....	5.60	4.90	4.95	5.10	5.00
12	5.40	12.00	7.80	7.80	5.90	5.90	.....	5.20	4.90	5.10	5.10	4.90
13	5.60	12.00	7.30	7.80	5.80	5.80	.....	5.10	5.10	5.10	5.15	5.05
14	5.50	12.00	6.90	7.30	5.60	7.10	.....	5.60	5.10	5.15	5.00	5.00
15	5.60	12.00	6.80	7.00	5.70	5.70	.....	5.20	5.05	5.10	5.20	5.00
16	5.60	12.00	6.30	6.80	5.70	5.60	.....	5.20	5.00	5.05	5.10	5.00
17	5.60	12.00	9.30	6.60	5.60	5.55	6.00	5.20	4.95	4.95	5.10	5.00
18	5.60	12.00	9.40	6.50	5.60	5.30	5.80	5.10	4.90	4.95	5.15	5.00
19	5.50	12.00	9.20	6.40	6.50	5.70	5.80	4.90	4.90	4.90	5.05	5.00
20	5.60	12.00	8.70	6.20	6.50	5.30	5.80	5.30	4.80	4.95	5.10	5.00
21	11.00	11.00	8.60	6.10	6.10	5.70	5.30	5.30	4.90	4.95	4.95	5.00
22	11.00	11.00	10.80	6.00	6.50	5.10	5.30	5.20	4.90	5.00	5.00	5.00

Mean daily gage height, in feet, of Cuyahoga River at Independence, Ohio, etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
23	12.00	11.00	9.60	6.20	6.50	5.70	6.30	5.80	4.85	5.10	5.05	5.10
24	12.00	11.00	9.00	6.20	7.50	5.70	5.80	5.50	4.85	5.00	5.10	5.15
25	12.00	11.00	16.30	7.30	7.30	5.60	5.50	5.20	4.90	5.20	4.80	5.40
26	12.00	11.00	15.20	7.00	7.00	5.30	5.50	5.50	4.85	5.20	4.90	5.55
27	12.00	10.80	12.10	7.40	10.40	5.20	5.50	5.30	5.10	5.10	4.85	8.75
28	12.00	11.00	11.60	7.80	8.80	5.50	5.90	5.20	5.10	5.05	4.90	7.65
29	12.00	16.00	10.60	8.80	8.20	5.40	5.50	5.20	5.00	5.05	5.05	6.55
30	12.00	.....	11.10	8.90	7.90	5.30	5.50	5.15	4.85	5.00	5.15	5.35
31	11.80	.....	11.00	.....	11.00	.....	5.50	5.05	.....	4.80	.....	5.35

[a] River frozen December 8 to 26.

NOTE.—High water January 21 to March 5 caused by ice gorge below station.

Rating table for Cuyahoga River at Independence, Ohio, from September 21, 1903, to August 23, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.40	56	6.00	550	7.60	1,178	10.20	2,408
4.50	82	6.10	586	7.70	1,220	10.40	2,516
4.60	109	6.20	623	7.80	1,263	10.60	2,624
4.70	137	6.30	660	7.90	1,306	10.80	2,734
4.80	166	6.40	698	8.00	1,350	11.00	2,845
4.90	195	6.50	736	8.20	1,439	11.50	3,137
5.00	225	6.60	774	8.40	1,530	12.00	3,445
5.10	255	6.70	812	8.60	1,622	12.50	3,765
5.20	286	6.80	852	8.80	1,715	13.00	4,090
5.30	317	6.90	892	9.00	1,809	13.50	4,424
5.40	349	7.00	932	9.20	1,903	14.00	4,770
5.50	381	7.10	972	9.40	1,999	14.50	5,120
5.60	414	7.20	1,012	9.60	2,096	15.00	5,470
5.70	447	7.30	1,053	9.80	2,196	16.00	6,170
5.80	481	7.40	1,094	10.00	2,300	17.00	6,870
5.90	515	7.50	1,136				

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1903 and 1904. It is well defined between gage heights 4.70 feet and 7.05 feet. The table has been extended beyond these limits. One flood measurement at gage height 14.65 determines the upper part of the curve. Above gage height 13.7 feet the rating curve is a tangent, the difference being 70 per tenth. Some change seems to have occurred in the channel between August 11, 1904, and September 16, 1904. The above table has been applied to the medial date of August 24, 1904. The table following has been made for the remaining portion of the year.

Rating table for Cuyahoga River at Independence, Ohio, from August 24 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.80	37	5.20	157	5.50	252	5.80	352
4.90	66	5.30	188	5.60	285	5.90	386
5.00	96	5.40	220	5.70	318	6.00	421
5.10	126						

The above table is applicable only for open-channel conditions. It is based upon 3 discharge measurements made during 1904, and parallels the curve for the first part of the year. This table is but a rough approximation.

Estimated monthly discharge of Cuyahoga River at Independence, Ohio, for 1903 and 1904.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1903.			
September 21–30	195	109	160
October	3,077	56	472
November [a]	2,248	56	337
1904.			
March 11–31	6,380	660	2,342
April	6,380	550	1,641
May	2,845	414	959
June	5,330	255	1,094
July [b]	774	317	546
August	812	111	288
September	157	37	92.7
October	157	37	104
November	157	37	109
December 1–7	142	10	76.1

[a] Discharge interpolated November 4 to 6, 1903.
[b] Discharge interpolated July 3 to 16, 1904.

NOTE.—The above estimates do not include the canal, which parallels the river.

LAKE ONTARIO DRAINAGE BASIN.

Lake Ontario drainage basin comprises an area of about one-fourth of the State of New York. The principal streams that drain this area are the Oswego River, formed by the Seneca and Oneida rivers, which drain the chain of lakes in central New York; the Genesee, Salmon, and Black rivers. The upper part of the drainage basin is mostly hilly pasture land, the lower part gently rolling, cultivated land.

OAK ORCHARD CREEK NEAR MEDINA, N. Y.

Oak Orchard Creek drains a swampy plateau having an elevation of 600 to 650 feet, lying in an easterly and westerly direction, south of Medina and Albion, N. Y.

At the western border of this swamp the stream turns northerly, crosses Erie Canal at Medina, and enters Lake Ontario at Point Breeze. The creek and its watershed are shown on the Albion, Medina, Ridgeway, and Oak Orchard sheets of the United States Geological Survey Topographic Atlas. The original Tonawanda Swamp had two outlets, the eastern end draining into Sandy Creek near Holly, N. Y., and the western end being tributary to Tonawanda Creek.

In 1824 a channel was cut across the western end of the Tonawanda Swamp entering Oak Orchard Creek, the object being to divert a portion of the flow of Tonawanda Creek to feed the long level of Erie Canal extending from Lockport to Rochester. This feeder channel intercepts the drainage from a portion of Tonawanda Creek watershed, including Whitney Creek, a small tributary. The flow from the diverting dam on Tonawanda Creek into the feeder channel is controlled by gates and is cut off, except during the season of canal navigation.

Water brought from lower Tonawanda Creek and from Lake Erie through the Erie Canal is passed over the waste weir at Medina, entering Oak Orchard Creek. The amount thus inverted to the watershed at times greatly exceeds that taken from Oak Orchard feeder for the supply of the canal; hence the importance of the stream for water-power purposes is chiefly confined to its lower course, about 18 miles, from Medina to its mouth. In this distance occurs a fall of 250 feet. The stream flows throughout much of the distance through a gulf cut in the drift overlying the Medina sandstone and affording a narrow flood plain.

A temporary gaging station was established on Oak Orchard Creek at Coon's bridge, which is located 6 miles from Medina along stream, and is just below the junction of Tonawanda feeder and the so-called Acker ditch, an artificial channel 2 miles in length leading Oak Orchard

Creek into the lower end of the feeder channel. The bridge has a single span of 60.8 feet between vertical masonry abutments. The low-water flow is confined in a central channel about 25 feet in width with hard gravel bed and smooth, uniform current, this channel having been excavated by the State of New York in 1894. A low-water gage, reading from zero to 4.5 feet, is attached vertically to a brace post underneath the downstream side of the bridge and at the right-hand side of the low-water channel.

The stream bends about 100 feet above the bridge, but is straight below, and the current passes underneath normal to the bridge. The remaining channel, unoccupied by the low-water course, is covered with silt and sand, with numerous willow bushes.

A secondary flood channel, having a width of 26 feet between abutments, is situated 283 feet to the right of the main bridge. Water also flows over a highway between the two bridges in extreme freshets.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Oak Orchard Creek. [a]

Location.	Place to place.	Total area.
	Sq. miles.	*Sq. miles.*
Above Coon's bridge	142.6	142.6
Above Medina feeder dam	8.1	150.7
Above Ridgeway	7.5	158.2
Above mouth	23.7	281.9
Swamp area	.....	32.0
Tonawanda Creek above diverting dam	.....	[b] 236.3

[a] From United States Geological Survey Topographic Atlas.
[b] From Bien's Atlas of New York.

Discharge measurements of Oak Orchard Creek near Medina, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 13	Horton and Mott	194	1.58	5.91	306
July 21	C. C. Covert	20	1.19	1.20	24

Mean daily gage height, in feet, of Oak Orchard Creek near Medina, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	1.90	.....	.....	9.38	5.68	2.40	1.10	0.92
2	1.95	.....	.....	9.25	5.42	2.25	1.32	.92
3	.....	.....	.....	8.90	5.28	2.08	1.30	.88
4	.....	.....	.....	8.80	5.00	2.00	1.30	.78
5	.....	.....	6.60	8.42	4.75	2.00	1.50	.78
6	.....	.....	7.20	8.08	4.40	1.92	1.50	.80
7	.....	6.80	8.58	7.60	4.10	1.82	1.55	.70
8	.....	.....	9.58	7.10	3.82	1.90	1.40	.70
9	.....	.....	9.70	6.82	3.50	1.98	1.35	.70
10	.....	7.50	10.00	6.50	3.25	1.90	1.45	.....
11	.....	7.60	10.60	6.25	3.05	1.82	1.35	.....
12	.....	7.40	10.20	6.05	2.85	1.72	1.55	.....
13	.....	7.05	9.60	5.88	2.65	1.68	1.60	.....
14	.....	.....	8.85	5.68	2.50	1.55	1.55	.....
15	.....	.....	8.02	5.45	2.60	1.48	1.80	.....
16	.....	.....	7.48	4.98	2.45	1.40	1.78	.....
17	.....	.....	6.80	5.15	2.30	1.32	1.70	.....
18	.....	.....	6.45	5.50	2.35	1.22	1.50	.....
19	.....	.....	6.22	5.85	2.38	1.20	1.38	.....
20	.....	.....	6.15	5.78	2.70	1.12	1.25	.....
21	.....	1.30	6.10	6.15	2.60	1.22	1.08	.....
22	.....	.....	6.88	6.45	2.35	1.18	1.22	.....
23	.....	.....	8.38	6.55	2.30	1.10	1.15	.....
24	2.50	.....	9.25	6.50	2.22	1.08	1.10	.....
25	.....	.....	10.00	6.98	2.15	1.08	1.10	.....
26	.....	.....	10.62	7.05	2.10	1.02	1.05	.....
27	.....	.....	10.38	6.85	2.00	1.00	1.00	.....
28	.....	.....	10.40	6.65	1.88	.98	1.05	.....
29	.....	.....	10.15	6.40	1.78	1.00	1.08	.....
30	.....	.....	9.58	6.25	1.75	1.05	.95	.....
31	2.30	.....	9.35	.....	1.90	.....	.98	.....

NOTE.—Creek frozen January 1 to March 4.

GENESEE RIVER NEAR MOUNT MORRIS, N. Y.

A current-meter gaging station was established at this point May 22, 1903. Observations of the stream stage are taken twice each day by J. T. Trewer, observer. The discharge measurements are made from a footbridge erected on the outriggers of the downstream side of the highway bridge, which consists of two spans of 174.3 and 31.7 feet, respectively. A weight and chain gage 15.50 feet in length is secured to the truss uprights near the center of the main bridge span on the upstream side. The bench mark is corner of wing wall left-hand abutment upstream side. Assumed elevation, 100.00 feet. Elevation datum plane of gage, 69.64 feet.

The river channel is of clay and straight for several hundred feet below the gage. About 300 feet above the bridge is an abrupt bend. The location of the gaging station and the course of the river from Jones Bridge to its outlet into Lake Ontario near Rochester is shown on the

Caledonia, Honeoye, and Rochester sheets of the United States Geological Survey Topographic Atlas. The gaging station is located a short distance below the inflow of Canaseraga Creek. The course of Genesee River below Mount Morris is very winding, traversing from side to side a flood plain 1½ miles average width. Owing to overflow on this flood plain, the high-water discharge is not determined at that point.

Cuba reservoir on the Genesee-Allegheny divide receives the drainage from a tributary area of 26.6 square miles. The storage volume is 454,000,000 cubic feet.[a] The overflow from this reservoir enters Allegheny River. The storage water may be turned into the summit level of the abandoned Genesee Valley canal, and thence into Genesee River.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Genesee River near Mount Morris, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 10[b]	C. C. Covert	3,870	2.45	25.30	9,413
April 12	Horton and Mott	1,071	4.35	11.86	4,658
July 16	C. C. Covert	250	2.57	5.25	644
November 10	Horton and Covert	180	2.14	4.60	387

Mean daily gage height, in feet, of Genesee River near Mount Morris, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.42	11.92	12.02	14.30	12.15	14.40	4.55	4.85	4.12	5.06	4.94	4.75
2	6.32	10.92	15.37	18.85	10.40	10.65	4.65	5.00	4.07	4.81	4.94	4.30
3	6.22	9.92	20.87	14.05	9.10	8.90	4.70	5.45	4.17	4.61	4.74	4.05
4	6.32	9.42	26.47	10.90	8.20	7.90	4.60	5.10	4.47	4.61	4.64	4.25
5	6.37	9.52	24.42	10.20	7.60	8.45	4.80	4.70	4.52	4.46	4.64	4.30
6	6.32	9.72	21.02	10.00	7.20	7.85	5.50	4.55	4.32	4.36	4.64	4.30
7	6.47	18.82	21.97	9.60	6.90	6.90	5.60	4.40	4.27	4.36	4.59	4.30
8	6.52	28.42	27.07	9.70	6.55	6.55	5.15	4.45	4.27	4.35	4.64	4.20
9	6.47	27.12	26.62	12.25	6.30	6.85	4.90	4.18	4.37	4.30	4.54	4.40
10	6.42	25.87	25.31	19.63	6.20	7.45	7.00	4.28	4.32	4.35	4.30	5.35
11	6.47	23.77	22.70	14.45	6.10	6.45	7.85	4.48	4.17	6.75	4.50	5.20
12	6.32	21.02	18.48	11.75	5.95	5.85	6.90	4.13	4.12	7.00	4.55	5.25
13	6.37	18.47	15.45	10.90	5.75	5.60	7.50	4.18	4.17	7.90	4.40	5.10
14	6.22	16.77	13.90	9.35	5.70	5.40	6.40	4.28	4.22	7.20	4.40	5.05
15	6.32	15.32	13.10	8.85	6.80	5.30	5.60	4.28	4.22	6.20	4.50	4.80
16	6.27	14.17	12.70	8.20	7.80	5.20	5.15	4.18	4.12	5.65	4.50	4.70
17	6.17	12.67	12.05	8.40	7.50	5.10	4.95	4.13	4.02	5.40	4.45	4.60
18	6.27	11.92	11.65	10.35	6.80	5.00	4.75	4.28	4.01	5.20	4.45	4.60
19	6.02	12.02	12.05	13.25	8.75	4.85	4.70	4.03	4.11	5.05	4.30	4.70

[a] Including Rockville reservoir.

[b] Backwater caused by ice jam.

Mean daily gage height, in feet, of Genesee River near Mount Morris, N. Y., for 1904— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
20	6.22	11.77	14.05	10.15	10.15	4.85	4.55	4.33	4.11	4.95	4.45	4.70
21	6.22	11.77	16.95	9.55	8.75	5.05	4.50	4.88	4.11	5.00	4.40	4.80
22	6.42	12.27	16.80	10.35	8.00	5.20	4.45	4.78	4.06	5.80	4.45	4.70
23	17.68	12.47	23.70	10.70	7.15	5.40	4.70	4.78	4.01	6.00	4.45	4.80
24	24.02	12.42	27.15	9.95	7.20	5.15	5.00	4.93	3.96	6.35	4.35	7.10
25	19.57	12.37	26.15	10.30	7.95	4.90	6.30	4.88	4.21	5.85	4.30	10.50
26	16.07	11.32	26.60	10.20	6.90	4.75	6.20	4.58	4.91	5.50	4.40	9.35
27	15.27	10.67	24.80	9.10	8.10	4.65	5.80	4.38	5.36	5.15	4.35	9.75
28	14.07	11.07	19.65	13.35	9.10	4.55	5.35	4.38	4.86	5.45	4.00	19.80
29	12.82	12.02	13.06	14.00	7.25	4.60	6.75	4.32	4.71	5.24	4.15	10.90
30	12.42	.....	11.20	13.25	6.70	4.55	6.60	4.22	5.01	5.19	4.45	7.80
31	12.27	.....	11.75	.....	12.90	.....	5.15	4.02	.....	5.04	.....	7.80

NOTE.—Owing to the swiftness of the current the river seldom freezes over at the gaging station.

Discharge measurements of Canaseraga Creek at Mount Morris, N. Y., in 1904.

Date.	Hydrographer.	Gage height.a	Discharge.
		Feet.	*Second-feet.*
April 12	Horton and Mott	17.42	1,048
July 16	C. C. Covert	21.2	242

a Distance to water surface below top of horizontal tie bar, 20 feet from left-hand end downstream side of bridge.

Discharge measurements of tailrace of Mount Morris power canal near Mount Morris, N. Y., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 16	C. C. Covert	2.05	107
November 10	Horton and Covert	2.08	116

GENESEE RIVER AT ROCHESTER, N. Y.

During the low-water seasons of 1903 and 1904 a series of current-meter measurements were made in the Carroll and Fitzhugh and Johnson and Seymour raceways, which receive their water supply from the Johnson and Seymour dam on Genesee River in Rochester. The stage of the water was below the crest of the dam at all times during the period while measurements were being taken, in 1904, with the exceptions noted on the tables. Measurements were taken both in daytime and at night to determine the relative day and night use of water for power purposes, the water being drawn down to the mini-

mum stage, and they therefore represent, as nearly as could be obtained, the natural low-water flow of the stream at this point. The Johnson and Seymour dam is of masonry, practically water-tight. It is located below the point of diversion from Genesee River to Erie Canal feeder, and the pond above the dam receives only the water supply available to the extensive power development at the three falls on the river, which occur within the city limits.

A record of the daily stage of Genesee River in the pond, measured at a point 15 feet upstream from Johnson and Seymour dam, has been kept, beginning March, 1893; a survey and profile of the dam have also been made. From these data the high-water discharge has been calculated.

In addition to the canal feeder mentioned, water is diverted from Allen Creek at Scottsville and brought down the abandoned Genesee Valley canal for the supply of Erie Canal at Rochester. The water supply of the city of Rochester is also drawn from Hemlock Lake, the outlet of which is tributary to Genesee River.

A standard cypress gage staff 16 feet in length, graduated decimally with galvanized-iron division marks, was secured to the downstream face of the first pier from the right-hand abutment of the Elmwood Avenue Bridge in Rochester, and readings of the stage have been taken under the direction of E. A. Fisher, city engineer. This gage is located above the State diverting dam, which causes, however, but little fluctuation in the level.

The bridge consists of three spans of about 125 feet each. The stream bed is of gravel, clean, and fairly permanent, and conditions are favorable for the use of a current meter.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Genesee River at Rochester, N. Y., in 1904.

Date.	Hydrographer.	Area.	Mean velocity.	Gage height.[a]	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
July 20	C. C. Covert	1,008	0.59	246.89	592
August 9	E. H. Fisher	976	.63	246.77	614
August 10	do	957	.62	246.69	589
August 11	do	944	.63	246.74	594
August 12	do	963	.69	246.79	667
August 15	do	973	.60	246.69	587
August 27	do	972	.72	246.82	703
August 30	do	916	.64	246.66	554
September 17	do	923	.56	246.64	511
November 11	C. C. Covert	994	.54	246.79	534

[a] City topographic datum.

Mean daily elevation of water surface above city datum of Genesee River at Rochester, N. Y., for 1904.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	250.49	250.29	250.59	246.99	247.29	246.59	246.99	246.99	246.69
2	.....	248.49	251.89	249.99	250.59	246.99	247.09	246.69	247.09	246.99	246.79
3	.....	252.19	251.79	248.59	249.39	247.09	246.99	246.69	246.99	246.99	246.79
4	.....	252.89	250.69	248.39	248.59	247.09	247.19	246.79	246.89	246.89	246.79
5	.....	252.89	249.79	248.29	248.39	246.99	247.19	246.79	246.79	246.89	246.79
6	.....	252.49	249.49	248.19	248.49	247.09	246.99	246.79	246.69	246.89	246.79
7	.....	252.29	249.39	248.09	248.29	247.19	246.99	246.69	246.69	246.89	246.79
8	.....	253.69	249.19	247.99	247.99	247.39	246.89	246.69	246.69	246.89	246.79
9	256.74	254.19	249.19	247.89	247.89	247.19	246.79	246.69	246.69	246.89	246.79
10	257.29	254.69	250.99	247.79	248.19	247.49	246.69	246.69	246.69	246.79	246.79
11	254.19	254.09	252.19	247.69	248.19	247.79	246.69	246.69	246.69	246.79	246.79
12	252.59	253.19	.....	247.64	247.99	247.99	246.69	246.69	247.59	246.79	246.79
13	(a)	251.29	.....	247.59	247.69	248.19	246.79	246.69	247.69	246.69	246.79
14	.....	249.79	.....	247.49	247.49	248.39	246.79	246.69	248.09	246.69	246.79
15	.....	248.79	249.09	247.79	247.49	247.79	246.69	246.69	247.89	246.69	246.79
16	.....	248.89	248.89	248.59	247.49	247.49	246.69	246.69	247.49	246.69	246.79
17	.....	248.49	248.89	248.69	247.39	247.39	246.69	246.69	247.29	246.69	246.79
18	.....	248.19	248.89	248.29	247.19	247.09	246.69	246.69	247.19	246.69	246.79
19	.....	248.09	250.99	248.39	247.09	246.99	246.69	246.59	247.09	246.69	246.79
20	.....	.....	250.59	249.39	247.04	246.89	246.69	246.59	246.99	246.69	246.79
21	.....	249.59	249.49	249.29	247.04	246.89	246.79	246.69	246.99	246.69	246.79
22	.....	.....	249.99	248.89	247.29	246.89	246.89	246.69	246.89	246.69	246.79
23	.....	251.69	250.09	248.59	247.39	246.89	246.99	246.69	247.09	246.69	246.79
24	.....	253.29	249.89	248.39	247.39	246.99	246.89	246.59	247.39	246.69	246.79
25	.....	253.49	249.89	248.19	247.19	247.29	246.89	246.59	247.49	246.69	246.89
26	.....	255.09	249.79	248.09	247.09	247.79	246.89	246.79	247.29	246.69	246.99
27	.....	255.99	249.49	247.89	246.99	247.69	246.79	246.89	247.19	246.69	248.09
28	.....	256.09	249.29	248.19	247.09	247.49	246.79	247.09	247.19	246.69	249.99
29	.....	254.69	251.39	248.39	246.99	247.39	246.69	246.99	247.19	246.69	252.19
30	.....	251.89	251.29	248.09	246.89	247.89	246.69	246.99	247.09	246.69	249.89
31	.....	250.29	.....	248.79	.....	247.49	246.59	.....	246.99	.....	248.89

[a] River frozen February 13–March 1, inclusive; no record.

Discharge measurements of Fitzhugh and Carroll race at Rochester, N. Y., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
June 30	E. H. Fisher	2.05	578
July 5	do	2.10	442
July 7	do	3.50	229
July 8	do	3.42	309
July 14	do	3.90	441
July 18	do	3.05	408
July 25	do	3.00	454

NOTE.—Discharge in raceway at given stage varies with running of turbines.

Discharge measurements of Johnson and Seymour race at Rochester, N. Y., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
June 30	E. H. Fisher	2.90	508
July 1	do	2.80	462
July 1	do	1.78	360
July 5	do	3.35	477
July 7	do	4.40	501
July 8	do	4.20	545
July 14	do	4.50	662
July 25	do	4.00	454

NOTE.—Discharge in raceway at given stage varies with running of turbines.

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

Canadice Lake is tributary to Genesee River through Hemlock Lake outlet and Honeoye Creek. The drainage basin is shown on the Honeoye and Wayland sheets of the United States Geological Survey Topographic Atlas.

Canadice Lake drains an area forming an irregular rectangle, the lake lying somewhat to the left of the longitudinal axis, with the greater portion of the drainage on the easterly slope. The westerly slope is narrow and precipitous; Bald Hill rising from altitude 1,090 feet at the lake to altitude 1,800 feet at the summit, the axis of the hill being parallel with the lake and an average of three-fourths mile distant therefrom.

The lake has a water surface area of 0.7 square mile and drains a total area of 12.6 square miles, 5.6 per cent of which is lake surface. A weir was constructed on the outlet at the foot of the lake by the city engineers department of Rochester, N. Y., in February, 1903. The entire yield of the drainage basin passes this weir. It consists of a standard thin-edged weir with a 5-foot crest and two end contractions, so arranged with needle timbers at the ends that the length may be increased to 14.96 feet with no end contractions during high water.

The weir crest stands 3 feet above the stream channel, and is never submerged by backwater. There are two additional rectangular gates, each 1 foot square, with three complete contractions, and a fourth partial contraction at the bottom. The outflow from the lake above the weir is controlled by gates. A reading of the depth on the weir is taken each morning, and also for each change of the gates; the depth being read to hundredths, and corrections being made for velocity of approach for the larger discharges.

The discharge is calculated by the Francis formula. The record has been furnished by E. A. Fisher, city engineer, and John F. Skinner, special assistant city engineer, of Rochester, N. Y.

Estimated monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1903.

[Drainage area, 12.6 square miles.]

Month.	Mean discharge in second-feet.	Mean elevation of lake above low water.	Run-off.	
			Second-feet per square mile.	Depth in inches.
February		1.08		
March		2.48		
April 26–30	[a] 7.85	3.04	0.623	0.695
May	8.33	2.42	.661	.760
June	8.50	1.87	.675	.756
July	8.03	2.09	.638	.734
August	6.44	1.57	.511	.588
September	4.50	1.45	.357	.400
October	4.04	1.40	.321	.369
November	5.08	1.42	.403	.451
December	5.90	1.27	.468	.538

[a] Mean for days observed taken as mean for entire month.

HONEOYE CREEK AT EAST RUSH, N. Y.

A gaging station was established February 13, 1903, on Honeoye Creek at the gristmill in the village of East Rush. The record includes the flow over the dam, which is of timber, having a crest varying somewhat in level 150.15 feet in length; also the discharge through two Leffel standard turbines, one 48 inches, the other 35 inches diameter. A record is kept of the head on the turbines and the number of hours each runs per day and the average gate opening. The latter is obtained by noting the number of gear teeth out of the total possible number through which the wheel gates stems may be turned to open the gates, allowance being made for lost motion. The bench mark on the window sill of the mill near flume is assumed at elevation 100.00, the gages being set with their zero marks as below:

Crest gage elevation	94.855
Tailrace gage	87.380
Difference	7.475

Honeoye Creek is the outlet of Honeoye Lake, which forms one of a group of narrow parallel lakes similar to the Finger Lakes of the Seneca River basin and located to the west of the latter. Honeoye Creek is joined 4 miles below its source by the combined outlet of Hemlock and Canadice lakes, which enters Genesee River near Rochester Junction. This group of lakes has areas and elevations as indicated below: [a]

[a] The drainage basin of Honeoye Creek is shown on the Honeoye, Canandaigua, Naples, and Wayland sheets of the U. S. Geological Survey topographic atlas, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys of Rochester waterworks.

Location.	Elevation.	Water-surface area.	Drainage area.	Per cent water surface.
	Feet.	*Sq. miles.*	*Sq. miles.*	
Hemlock Lake	896	2.8	46.8	6.12
Canadice Lake	1,092	0.7	12.6	5.57
Honeoye Lake	800	2.5	39.6	6.41

Honeoye Creek enters Genesee River at Genesee Valley Junction. The entire drainage area is approximately rectangular, having a length of 30 miles; average width, 9.5 miles. The fall of 280 feet in the course of the stream has been largely utilized by the construction of dams.

The lakes, which serve as natural reservoirs, have inlets draining considerable areas at their uppermost ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gulleys and torrential brooks. The area below the lakes is rolling, the soil rich and extensively cultivated. The stream tributaries are not numerous, but ramify in such manner as to give good drainage of all portions of the area.

The diversion from Hemlock Lake by the city of Rochester is to be added to the measured run-off at East Rush to obtain the total yield of the drainage basin. The average diversion rate is about 22 second-feet.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Honeoye Creek.

Location.	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Hemlock Lake, above outlet	46.8	.....
Hemlock Lake outlet to Canadice Lake outlet	.1	46.9
Canadice Lake, above outlet	12.6	.....
Canadice Lake outlet to Hemlock Lake outlet	18.9	31.5
Junction of Hemlock and Canadice Lake outlets	.....	78.4
Hemlock Lake outlet, from junction to Honeoye Creek	15.6	94.0
Honeoye Lake, above outlet	39.6	.....
Honeoye Creek, from lake outlet to junction of Hemlock Lake outlet	31.7	71.3
Honeoye and Hemlock Lake outlets at junction	.....	165
Honeoye Creek junction to Honeoye Falls	44.0	209
Honeoye Falls to East Rush	50.0	260
Honeoye Creek, East Rush to mouth	28.0	288

Mean daily discharge, in second-feet, of Honeoye Creek at East Rush, N. Y., for 1903 and 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1	(a)		(b)	490	108	55	108	65	225	33	34	31
2			293	381	108	55	108	(b)	129	33	33	32
3			293	417	(b)	55	76	44	85	33	(b)	36
4			263	2,710	86	55	(b)	44	85	(b)	34	32
5			323	(b)	86	76	(b)	225	65	33	52	32
6			420	608	108	35	76	173	(b)	33	69	(b)
7			353	690	86	(b)	76	129	44	33	74	36
8			(b)	526	86	35	76	85	44	37	(b)	31
9			1,295	526	86	35	76	(b)	33	129	61	33
10			652	381	(b)	35	76	129	33	75	43	32
11			1,014	245	66	55	55	85	65	(b)	43	45
12			614	(b)	76	55	(b)	85	65	65	43	59
13		265	526	305	76	76	55	65	(b)	55	32	(b)
14		145	526	305	66	(b)	55	65	44	44	39	38
15		(b)	(b)	526	76	76	76	44	55	44	(b)	29
16		219	381	690	66	76	76	(b)	55	44	43	29
17		85	417	526	(b)	76	76	44	44	33	104	39
18		294	417	363	55	76	76	44	85	(b)	150	25
19		234	381	(b)	66	76	(b)	44	65	65	82	23
20		212	345	256	66	76	76	44	(b)	65	53	(b)
21		294	369	286	66	(b)	76	44	33	55	57	34
22		(b)	(b)	256	55	76	55	85	33	44	(b)	52
23		146	972	226	55	108	196	(b)	33	43	52	56
24		146	1,427	174	(b)	76	152	65	32	38	71	46
25		135	875	171	66	174	86	65	32	(b)	136	(b)
26		168	608	(b)	66	196	(b)	129	32	33	(b)	60
27		155	608	152	55	108	66	173	(b)	33	59	(b)
28		617	527	152	76	(b)	66	173	32	37	53	43
29			(b)	152	66	108	66	173	32	38	(b)	33
30			315	130	(b)	2,263	66	(b)	32	39	32	33
31			444		(b)		66	173		34		33
1904.												
1	(b)		520	366	(b)	407	25	80	c 15	68	32	15
2	26		445	472	193	254	24	32	c 14	67	53	35
3	(b)		1,014	(b)	193	150	(b)	c 10	24	67	26	39
4	26		1,309	301	172	105	(b)	c 11	(b)	43	53	c 7
5	17		682	253	150	(b)	25	22	31	49	39	23
6	22		(b)	323	126	126	18	31	28	67	(b)	50
7	31		1,528	193	106	95	16	(b)	26	34	27	40
8	37		2,188	171	(b)	73	22	31	26	38	50	49
9	31		718	175	106	82	(b)	31	19	(b)	50	27
10	(b)		553	(b)	106	82	(b)	31	31	43	44	26
11	31		367	253	106	68	191	24	(b)	47	44	c 7
12	31		302	193	106	(b)	69	49	42	68	37	26
13	31		(b)	149	106	87	131	50	18	68	c 7	26
14	20		305	171	69	82	60	(b)	52	67	27	24
15	19		275	127	(b)	82	34	29	28	52	52	34
16	13		186	68	415	60	34	36	36	(b)	56	32
17	(b)		560	(b)	312	56	(b)	36	57	67	50	32
18	36		410	223	253	23	30	36	(b)	31	22	c 7
19	19		483	518	379	(b)	14	36	46	23	29	27
20	31		(b)	343	476	30	c 15	35	55	30	c 7	26

a Stream frozen from January 1 to February 12, 1903.
b Sunday or holiday; no record. No estimate made owing to pondage.
c Flow held back by pondage.

Mean daily discharge, in second-feet, of Honeoye Creek at East Rush, N. Y., etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
21	21	.....	445	172	304	23	a 10	(b)	54	27	46	34
22	31	.....	445	451	(b)	33	a 5	49	46	41	46	32
23	91	.....	1,357	563	193	36	a 10	36	32	(b)	61	32
24	(c)	.....	816	(b)	223	27	(b)	36	23	37	a 7	36
25	.....	190	964	343	149	32	126	a 12	(b)	38	41	48
26	.....	70	1,065	223	132	(b)	123	a 13	68	38	40	35
27	.....	102	(b)	193	123	32	112	a 13	66	38	a 7	153
28	.....	(b)	522	223	129	32	40	(b)	66	38	61	418
29	.....	563	377	450	(b)	24	132	21	283	38	63	56
30	.....	.....	341	342	145	24	69	31	65	38	66	45
31	.....	.....	310	.....	122	.....	(b)	17	.....	31	.....	35

a Flow held back by pondage.
b No record.
c Stream frozen January 24 to February 24, inclusive; record not available.

Estimated monthly discharge of Honeoye Creek at East Rush, N. Y., for 1903 and 1904.

[Drainage area, 238 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.b	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
January a	.....	.....	.....	.....	.....
February, 16 days	617	.....	222	0.933	0.486
March, 26 days	1,427	.....	564	2.37	2.29
April, 26 days	2,710	.....	448	1.88	1.82
May, 25 days	108	.....	74.9	.315	2.92
June, 26 days	2,263	.....	161	.677	.655
July, 26 days	196	.....	81.2	.341	.304
August, 26 days	225	.....	95.9	.403	.330
September, 26 days	225	.....	54.3	.228	.220
October, 27 days	129	.....	45.8	.193	.194
November, 24 days	136	.....	60.4	.254	.227
December, 26 days	60	.....	37.3	.157	.152
1904.					
January, 19 days a	.....	.....	29.7	.125	.884
February a	.....	.....	.....	.....	.....
March, 27 days	2,188	.....	685	2.88	2.89
April, 26 days	563	.....	279	1.17	1.13
May, 26 days	476	.....	188	.790	.764
June, 26 days	407	.....	81.7	.343	.332
July, 24 days	191	.....	55.6	.234	.209
August, 27 days	80	.....	31.0	.130	.130
September, 26 days	283	.....	48.1	.202	.195
October, 28 days	68	.....	46.2	.194	.202
November, 29 days	66	.....	39.4	.166	.179
December	418	.....	46.3	.195	.225

a Stream frozen January 1 to February 12, 1903; also January 24 to February 24, 1904.
b Regimen of stream disturbed by pondage.

NOTE.—This discharge does not include the diversion from Hemlock Lake for water supply for Rochester.

SKANEATELES LAKE OUTLET AT WILLOWGLEN, N. Y.[a]

The daily discharge over a thin-edged weir, located in the village of Willowglen, 1½ miles below the foot of Skaneateles Lake, has been observed, beginning March 10, 1895. The weir has a crest length of 27 feet, with two end contractions. The discharge is calculated from the observed depth on a stake set with its top at crest level 5.2 feet upstream from the weir, by means of the Francis formula, including corrections for end contractions and velocity of approach.

Beginning July 1, 1894, the water supply of the city of Syracuse has been drawn from Skaneateles Lake and the amount of its diversion should be added to the discharge over Willowglen weir to obtain the total run-off from the drainage basin. The calculated diversion, as determined from the record of gate openings and head at the inlet gates, using the formula for orifices with a constant coefficient stated as 0.62, have been furnished by the city of Syracuse. The observations were taken at the weir and gates by Edward Conron.

Drainage areas of Skaneateles Lake.[a]

Location.	Area.
	Sq. miles.
Land surface above State dam at Skaneateles	60.25
Water surface of lake at Skaneateles	12.75
Total drainage area above foot of lake	73.00
(Water surface above foot of lake is 17.46 per cent.)	
Total area above Willowglen weir	74.25
Area above Erie Canal at Jordan	93.00

[a] Areas here given have been taken from proceedings in condemnation of water powers on Skaneateles outlet. The lake and its tributary area are shown on the Skaneateles, Tully, Cortland, and Moravia sheets of the U. S. Geological Survey topographic atlas.

The lake surface is at an elevation about 865 feet above tide.

The average width of the land surface on the two sides of the lake is 2½ miles. In this distance occurs a rise of 400 to 800 feet, the greater portion being within 1 mile of the lake on either side. The surface inflow takes place through numerous short lateral feeders flowing down these slopes.

Skaneateles Lake outlet enters Seneca River above Cross Lake, crossing Erie Canal at Jordan. The fall from the foot of the lake to this point is 465 feet.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

[a] For complete description of gagings which have been made of this stream, see Report on Stream Gagings, contained in Supplement, Report of State Engineer and Surveyor of New York for 1902 pp. 61 to 76.

Mean daily discharge,[a] in second-feet, of Skaneateles Lake outlet at Willowglen, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	91.2	74.7	80.0	116.2	146.0	129.2	91.2	91.2	122.7	103.4	103.4	85.5
2	91.2	69.6	82.8	122.7	146.0	129.2	91.2	91.2	122.7	103.4	103.4	85.5
3	91.2	69.6	88.3	116.2	146.0	129.2	91.2	91.2	135.8	103.4	103.4	85.5
4	91.2	74.7	85.5	109.8	142.5	129.2	91.2	91.2	135.8	103.4	103.4	85.5
5	91.2	80.0	85.5	109.8	142.5	129.2	91.2	91.2	135.8	106.6	103.4	85.5
6	91.2	97.2	85.5	109.8	142.5	129.2	91.2	91.2	135.8	106.6	103.4	85.5
7	91.2	109.8	122.7	109.8	142.5	129.2	91.2	97.2	135.8	103.4	100.3	85.5
8	91.2	116.2	116.2	109.8	142.5	129.2	91.2	119.4	119.4	103.4	100.3	85.5
9	91.2	100.3	85.5	109.8	142.5	129.2	91.2	119.4	119.4	103.4	100.3	82.8
10	91.2	94.2	74.7	106.6	142.5	129.2	91.2	119.4	119.4	103.4	100.3	82.8
11	91.2	91.2	69.6	106.6	142.5	129.2	91.2	119.4	103.4	106.6	97.2	80.0
12	91.2	85.5	91.2	103.4	116.2	129.2	91.2	119.4	103.4	106.6	97.2	72.2
13	91.2	80.0	72.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	97.2	72.2
14	91.2	80.0	72.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	97.2	74.7
15	91.2	80.0	85.5	103.4	116.2	125.9	91.2	119.4	103.4	103.4	91.2	74.7
16	91.2	80.0	97.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	88.3	74.7
17	91.2	74.7	97.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	85.5	74.7
18	91.2	74.7	97.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	85.5	74.7
19	91.2	72.2	97.2	103.4	109.8	125.9	91.2	119.4	103.4	103.4	85.5	74.7
20	91.2	80.0	97.2	122.7	109.8	97.2	91.2	119.4	109.8	103.4	85.5	74.7
21	94.2	85.5	97.2	129.2	109.8	94.2	91.2	122.7	103.4	109.8	85.5	74.7
22	103.4	82.8	100.3	129.2	109.8	91.2	91.2	122.7	103.4	116.2	85.5	69.6
23	109.8	82.8	106.6	129.2	109.8	91.2	91.2	122.7	103.4	106.6	85.5	69.6
24	113.0	82.8	113.0	129.2	129.2	91.2	91.2	122.7	103.4	103.4	85.5	72.2
25	100.3	85.5	135.8	129.2	129.2	91.2	91.2	122.7	109.8	103.4	85.5	72.2
26	97.2	82.8	119.4	129.2	129.2	91.2	91.2	122.7	109.8	103.4	85.5	72.2
27	94.2	85.5	116.2	142.5	129.2	91.2	135.8	122.7	103.4	103.4	85.5	80.0
28	91.2	88.3	103.4	149.5	129.2	91.2	135.8	122.7	103.4	103.4	85.5	88.3
29	91.2	82.8	103.4	142.5	129.2	91.2	135.8	122.7	106.6	103.4	85.5	85.5
30	91.2	.....	103.4	142.5	129.2	91.2	135.8	122.7	103.4	103.4	85.5	82.8
31	91.2	.....	109.8	.....	129.2	.....	91.2	122.7	.....	103.4	.....	82.8

[a] Actual flow in outlet, not including diversion.

Estimated monthly discharge of Skaneateles Lake outlet[a] at Willowglen, N. Y., for 1904.

[Drainage area, 74.2 square miles.]

Month	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	113.0	91.2	93.6	1.26	1.45
February	116.2	69.6	84.3	1.14	1.23
March	135.8	69.6	96.5	1.30	1.50
April	149.5	103.4	117.6	1.59	1.77
May	146.0	109.8	127.2	1.71	1.97
June	129.2	91.2	114.8	1.55	1.73
July	135.8	91.2	97.1	1.31	1.51
August	122.7	91.2	114.4	1.54	1.78
September	135.8	103.4	112.4	1.52	1.68
October	116.2	103.4	104.5	1.41	1.63
November	103.4	85.5	92.9	1.25	1.40
December	88.3	69.6	78.9	1.06	1.22
The year	149.5	69.6	102.8	1,39	18.87

[a] Actual flow in outlet, not including diversion.

Estimated monthly discharge of Skaneateles Lake outlet[a] near Willowglen, N. Y., for 1903 and 1904.

[Drainage area, 74.2 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	In outlet.	Through conduit.	Total.	Second-feet per square mile.	Depth in inches.
1903.					
November	113.0	19.1	132.1	1.78	1.99
December	91.4	17.5	108.9	1.47	1.70
1904.					
January	93.6	18.4	112.0	1.51	1.74
February	84.3	18.4	102.7	1.38	1.49
March	96.5	18.2	114.7	1.55	1.79
April	117.6	19.6	137.2	1.85	2.06
May	127.2	18.9	146.1	1.97	2.27
June	114.8	19.0	133.8	1.80	2.02
July	97.1	20.0	117.1	1.58	1.82
August	114.4	19.5	133.9	1.80	2.08
September	112.4	18.7	131.1	1.77	1.98
October	104.5	19.6	124.1	1.67	1.92
November	92.9	17.2	110.1	1.48	1.65
December	78.9	17.5	96.4	1.30	1.50
The year			121.6	1.64	22.30

[a] Including diversion for municipal water supply of Syracuse, N. Y.

OSWEGO RIVER AT BATTLE ISLAND, N. Y.

Oswego River is formed by the confluence of Oneida and Seneca rivers at Three River Point. The stream is shown throughout its course of 24 miles on the Oswego Special and Baldwinsville sheets of the United States Geological Survey Topographic Atlas. The drainage tributary to the river below the junction of Oneida and Seneca rivers is of small extent. The tributaries of Oswego River proper are neither large nor numerous, receiving the drainage from a number of small lakes and marshes in a moderately rolling basin. Oneida and Seneca rivers are both notable for the large extent of lake and marsh area contained within their basins, Oneida Lake in the former and the Finger Lakes tributary to the latter streams affording extensive natural storage regulation of flow to Oswego River.

A fall of 100 feet in the course of Oswego River is mainly utilized by seven dams, which also partially canalize the stream. The intervening stretches are covered by the Oswego canal, which draws its

water supply from the river. The accompanying tables of discharge show the actual flow past the gaging station, not including the flow in Oswego canal.[a]

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurement of Oswego River at Battle Island, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 24	C. C. Covert	2,051	3.36	87.15	6,891
November 18	Covert and Weeks	1,640	2.44	86.15	4,002

Mean daily elevation of water surface of Oswego River at Battle Island, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	87.85	90.10	91.25	94.15	92.10	89.15	86.78	85.75	85.10	85.35	86.65	85.75
2	88.20	89.85	91.38	94.25	92.15	89.03	86.55	85.50	85.05	84.95	86.60	85.75
3	88.80	89.75	91.25	94.25	92.02	88.90	86.15	85.40	85.12	85.85	86.65	85.65
4	88.95	89.78	91.32	94.22	91.90	88.70	86.35	85.30	84.62	85.85	86.57	85.85
5	89.00	89.75	91.25	94.05	91.90	87.83	86.50	85.22	85.10	85.95	86.40	86.15
6	89.05	89.65	91.18	93.95	91.82	87.75	86.42	85.20	85.05	85.95	85.75	85.95
7	89.10	89.70	91.75	93.78	91.50	87.80	86.18	85.10	85.10	86.00	87.05	85.90
8	89.05	90.53	92.80	93.50	91.45	87.85	86.35	85.50	85.08	86.02	86.55	85.95
9	89.02	91.23	93.45	93.40	91.38	87.87	86.25	85.28	85.05	85.35	86.35	85.95
10	89.05	91.50	93.50	93.48	91.05	87.90	86.00	85.12	84.98	86.35	86.40	85.63
11	89.05	91.45	93.38	93.60	90.82	88.05	86.32	85.05	84.48	86.33	86.35	85.20
12	89.05	91.35	93.15	93.52	90.62	88.00	86.15	84.90	84.90	86.40	86.25	85.60
13	89.10	91.32	93.00	93.40	90.30	88.12	86.22	84.78	85.20	86.55	85.40	85.50
14	89.07	91.60	92.98	93.38	90.08	88.10	86.25	85.20	85.10	86.50	86.70	85.50
15	89.13	91.25	92.85	93.20	90.05	87.95	86.38	85.15	85.22	86.40	86.37	85.45
16	89.33	90.90	92.65	93.05	90.05	87.85	86.45	84.90	85.25	85.90	86.15	85.35
17	89.15	90.70	92.55	92.95	89.95	87.72	85.50	84.98	85.05	86.80	86.05	85.35
18	88.85	90.65	92.45	92.88	89.98	87.75	86.25	84.80	84.25	86.65	86.13	85.25
19	89.02	90.65	92.35	92.88	89.92	87.55	86.18	84.90	85.22	86.45	86.00	85.50
20	89.25	90.50	92.08	92.85	89.88	87.52	86.02	85.10	85.08	86.33	85.35	85.65
21	89.28	90.60	92.15	92.68	89.85	87.45	85.75	84.75	85.15	86.37	86.30	85.50
22	89.50	90.58	92.25	92.48	89.70	87.35	85.60	84.98	85.10	86.47	86.00	85.45
23	89.00	90.40	92.70	92.50	90.00	87.30	85.65	85.40	85.05	86.10	86.10	85.25
24	88.95	90.30	92.82	92.38	89.90	87.15	85.15	85.58	85.18	87.10	86.13	85.10
25	89.25	90.20	93.70	92.25	89.68	87.07	85.80	85.40	84.48	86.70	86.00	84.95
26	89.65	90.35	94.05	92.22	89.68	86.75	85.55	85.20	85.92	86.70	85.60	85.40
27	89.85	90.18	94.05	92.15	90.12	87.00	85.50	85.10	85.40	86.65	85.60	85.25
28	90.00	91.15	94.05	92.15	90.35	86.95	85.02	84.60	85.38	86.85	86.05	87.80
29	90.12	91.48	93.82	92.20	89.40	86.85	85.32	85.50	85.70	86.67	85.85	88.10
30	90.10	.....	94.05	92.28	89.35	86.85	85.32	85.15	85.60	86.20	85.80	88.45
31	89.72	.....	94.18	.....	89.25	.....	85.00	85.12	.....	87.00	.....	88.45

[a] For additional data of gagings of Oswego River see Report on Stream Gagings, contained in Supplement, Report of State Engineer and Surveyor of New York for 1902, pp. 84–96; also 1903, pp. 41–42.

Rating table for Oswego River at Battle Island, N. Y., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
83.00	1,280	84.60	2,630	86.40	5,050	89.60	11,280
83.10	1,350	84.70	2,740	86.60	5,380	89.80	11,710
83.20	1,420	84.80	2,860	86.80	5,730	90.00	12,150
83.30	1,480	84.90	2,970	87.00	6,080	90.20	12,590
83.40	1,550	85.00	3,080	87.20	6,450	90.40	13,020
83.50	1,620	85.10	3,210	87.40	6,820	90.60	13,460
83.60	1,700	85.20	3,340	87.60	7,200	90.80	13,910
83.70	1,790	85.30	3,460	87.80	7,590	91.00	14,360
83.80	1,870	85.40	3,590	88.00	7,990	91.50	15,490
83.90	1,950	85.50	3,720	88.20	8,390	92.00	16,630
84.00	2,040	85.60	3,860	88.40	8,790	92.50	17,830
84.10	2,140	85.70	4,000	88.60	9,200	93.00	19,000
84.20	2,230	85.80	4,150	88.80	9,610	93.50	20,190
84.30	2,330	85.90	4,290	89.00	10,020	94.00	21,400
84.40	2,420	86.00	4,430	89.20	10,440	94.50	22,610
84.50	2,520	86.20	4,740	89.40	10,850		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1904. It is well defined between gage heights 85 feet and 93 feet. Below 85 the curve is based on 1 measurement at 83.6. The table has been extended beyond these limits.

Estimated monthly discharge of Oswego River at Battle Island, N. Y., for 1904.

[Drainage area, 4,990 square miles.]

Month.	Drainage in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January[a]					
February[a]					
March[a]					
April	22,000	16,990	19,330	3.87	4.32
May	16,990	10,540	13,320	2.67	3.08
June	10,330	5,640	7,497	1.50	1.67
July	5,680	3,080	4,416	.885	1.02
August	4,070	2,630	3,291	.660	.761
September	4,320	2,280	3,223	.646	.721
October	6,260	3,020	4,904	.983	1.13
November	6,170	3,530	4,719	.946	1.06
December[a]					

[a] Probable ice conditions January 1 to March 31; December 1–31.

SENECA RIVER AT BALDWINSVILLE, N. Y.

This station was established November 12, 1898.[a] The gaging station is located at the State dam in Baldwinsville, 12 miles along the river from the junction of Seneca River with Oneida River. These two streams unite at Three River Point to form Oswego River.

Seneca River receives the drainage from the central group of lakes lying southward from Lake Ontario. The drainage basin is rolling, though not precipitous, excepting for the deep, narrow valleys crossing it, in which the lakes are situated, and certain additional valleys not at the present time occupied by lakes.

The location of the gaging station is shown on the Baldwinsville sheet of the United States Geological Survey Topographic Atlas. The topographic sheets also show the entire drainage basin. Current-meter measurements, to determine the leakage of the several mills, have been made during 1904, as in preceding years, and the allowance for this leakage has been made. The record has also been checked by current-meter measurements made during 1901, 1903, and 1904 at Belgium. The discharge at New Bridge, Belgium, April 15, 1904, was 10,615 second-feet.

The gaging record at Baldwinsville includes the discharge over the main dam, which is calculated by the formula for a broad, flat-crested weir when flashboards are removed. Discharge over flashboards is calculated by the Francis formula. Gage readings in the river channel below the dam are utilized to determine the average working head on turbines. Discharge through the three main canals is determined from records of the run of water wheels kept in each mill, and from the recorded lockage and opening of paddles at the Oswego Canal lock at the foot of the canal.[b]

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

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[a] By George W. Rafter for U. S. Board of Engineers on Deep Waterways.

[b] See Report State Engineer and Surveyor of New York, Supplement, 1902, pp. 77–81, 1903, pp. 39–40.

Mean daily discharge, in second-feet, of Seneca River at Baldwinsville, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,270	4,270	4,130	10,220	6,770	5,850	3,530	2,700	1,630	1,850	2,940	2,690
2	2,480	3,970	4,100	10,230	7,910	5,800	3,540	2,460	1,630	1,220	2,940	2,690
3	1,360	3,760	4,230	9,850	7,610	5,610	2,750	2,540	1,630	2,160	2,980	2,500
4	2,080	3,800	4,450	10,010	7,610	5,610	3,800	2,460	840	2,260	2,940	1,740
5	2,180	3,670	4,830	9,810	7,490	4,730	3,040	2,390	2,170	2,170	2,770	2,560
6	2,260	3,460	4,410	9,600	7,190	5,550	3,500	2,380	1,850	1,960	2,250	2,510
7	2,240	3,620	5,180	9,460	7,050	5,360	3,500	1,600	1,670	1,860	3,010	2,530
8	2,210	4,400	6,280	9,230	6,280	5,240	3,450	2,300	1,830	1,820	2,890	2,550
9	2,340	4,880	6,540	9,080	6,760	5,300	3,400	2,440	1,830	1,150	2,970	2,410
10	1,870	5,280	6,810	8,740	6,590	5,180	2,440	2,400	1,830	2,150	2,930	2,440
11	2,370	5,300	6,940	8,950	6,400	5,240	3,190	1,820	1,200	2,140	2,970	1,330
12	2,280	5,150	6,940	8,900	6,200	4,220	3,140	2,060	1,850	2,160	2,830	2,100
13	2,240	5,270	6,620	8,680	6,120	5,120	3,060	2,170	1,700	2,170	2,110	1,970
14	2,320	4,950	7,130	8,450	6,060	4,930	3,110	1,610	1,700	2,020	2,820	1,950
15	2,280	5,300	7,080	8,370	5,340	4,810	3,060	2,240	1,730	1,920	2,790	2,150
16	2,320	5,330	7,080	8,150	5,990	4,810	3,110	2,100	1,700	1,770	2,850	2,160
17	1,840	5,050	6,870	7,630	6,060	4,520	2,340	2,100	1,700	2,480	2,780	2,260
18	2,170	4,850	6,580	8,270	5,800	4,630	2,890	2,040	1,230	2,400	2,700	1,380
19	1,840	4,720	6,500	8,110	6,060	3,740	2,700	1,970	1,970	2,420	2,660	2,880
20	2,060	4,410	6,040	8,180	6,060	4,460	2,570	2,340	1,840	2,260	1,610	2,340
21	1,960	4,070	6,620	8,030	6,210	4,160	2,390	1,610	1,860	2,520	2,770	2,320
22	2,120	5,010	6,720	7,730	5,620	4,290	2,430	2,210	1,870	2,700	2,690	2,320
23	2,380	4,480	7,640	8,240	6,390	4,170	2,480	2,170	1,860	2,240	2,560	2,240
24	2,620	4,370	7,990	7,860	6,260	4,170	1,720	1,760	1,920	3,080	2,660	2,170
25	3,530	4,290	8,580	8,050	6,350	4,170	2,390	1,710	800	2,850	2,470	1,480
26	3,730	4,460	9,600	8,050	6,350	3,280	2,380	1,890	1,910	2,780	2,430	2,270
27	3,900	4,150	9,550	7,970	6,350	4,120	2,280	1,910	2,040	2,770	1,820	2,570
28	4,220	3,850	10,310	7,970	6,210	3,920	2,420	1,320	1,970	2,790	2,500	3,250
29	4,680	4,105	10,290	8,120	5,500	3,640	2,430	2,000	1,800	2,810	2,430	3,800
30	4,300	.....	10,260	7,940	6,400	3,550	2,510	1,650	1,750	2,410	2,410	3,850
31	3,950	.....	10,250	.....	6,060	.....	1,830	1,660	.....	2,870	.....	3,840

NOTE.—Ice formed on portion of crest of dam during January and February. Discharge may be excessive.

Estimated monthly discharge of Seneca River at Baldwinsville, N. Y., for 1904.

[Drainage area, 3,103 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,680	1,360	2,594	0.836	0.964
February	5,330	3,460	4,490	1.45	1.56
March	10,310	4,100	6,986	2.25	2.59
April	10,230	7,630	8,663	2.79	3.11
May	7,910	5,340	6,421	2.07	2.39
June	5,850	3,280	4,673	1.51	1.68
July	3,800	1,720	2,818	.908	1.05
August	2,700	1,320	2,065	.665	.767
September	2,170	800	1,711	.551	.615
October	3,080	1,150	2,266	.730	.842
November	3,010	1,610	2,647	.853	.952
December	3,850	1,330	2,411	.777	.896
The year	10,310	800	3,979	1.28	17.42

ONONDAGA LAKE OUTLET AT LONG BRANCH, N. Y.

Readings have been taken showing the stage of this stream on a vertical staff gage graduated decimally and having its zero mark at elevation 360.81, located 800 feet upstream from Long Branch highway bridge. Current-meter measurements have also been made to determine the outflow from Onondaga Lake. The discharge is not a continuous function of the stage of the stream, however, owing to the variation in the water level of Seneca River, which forms the outlet of the lake, and to the growth of grass and aquatic plants in the stream channel.

Onondaga Lake receives the drainage from an irregular pear-shaped area; the broad end, 17 miles in width, extends east and west just west of Syracuse, the lake lying near the northern boundary. The length of the drainage basin is 25 miles, the apex lying in the Tully Lake region. The altitude of Onondaga Lake is 364 feet. The general elevation of the flats surrounding the lake and extending eastward to the boundary of the drainage area is 400 feet. The surface rises rapidly to elevation 800 feet on a line crossing the basin immediately south of Syracuse. South of this line the topography is bold, broad hills 2 to 4 miles in diameter rising to altitudes of from 1,200 to 1,800 feet.

Otisco Lake here occupies the western portion of the main drainage basin, and comprises approximately one-third the total area. The

lake is at an elevation of 784 feet, and its drainage basin is at an average altitude about 200 feet greater than that of Onondaga Creek. Otisco Lake lies parallel to and at a distance of 2¾ miles from Skaneateles Lake. The latter is at elevation 867 feet; the difference of level between the two lakes being 83 feet. They are separated by a ridge rising to elevation 1,700 feet.

The Tully Lakes are located in a flat-bottomed valley from 1 to 2 miles wide. Two of these lakes have a southerly outlet to Tioughnioga River; the remaining lakes have no surface outlets. Just north of these lakes the valley drops rapidly from elevation 1,200 to elevation 900, within a distance of one-half mile, and on this slope, within a short distance of Tully Lakes, spring-fed streams rise forming the headwaters of Onondaga Creek.

The drainage area is largely rich agricultural land. There are no extensive marshes. Stream tributaries are rather sparse and the steep hillside slopes are usually smooth in the Onondaga Creek basin, but serrated and with numerous short lateral streams in the Otisco basin. The combined water surface of Onondaga and Otisco Lakes is 8 square miles, or 2.8 per cent of the total drainage area.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Onondaga Creek.[a]

Location.	Areas.	
	Place to place.	Total.
Otisco Lake:	*Sq. miles.*	*Sq. miles.*
Above foot of lake[b]	44.7	44.7
Otisco Lake water surface	.....	3.3
Nine Mile Creek, foot of lake to mouth	74.0	118.7
Onondaga Creek:		
Above junction West Branch	40.6	40.6
Junction West Branch to mouth	65.3	105.9
Onondaga Lake:		
Total area above outlet[b]	.....	288.4
Water surface	.....	4.7
Onondaga Lake outlet:		
Long Branch to mouth	3.0	291.4

[a] From Syracuse, Baldwinsville, Skaneateles, and Tully sheets of the United States Geological Survey Topographic Atlas.
[b] Including water surface.

Discharge measurements of Onondaga Lake outlet at Long Branch, N. Y., in 1904.

Date	Hydrographer.	Gage height.[a]	Discharge.
		Feet.	*Second-feet.*
April 15	Covert and Swancott	7.60	[b]563
April 25	C. C. Covert	6.80	774
May 5	do	6.40	805
May 18	do	4.80	796
May 27	C. A. Swancott	4.70	605
July 30	do	2.45	[c]276
September 2	do	2.10	338
November 19	Covert and Weeks	1.80	331

[a] Barge canal gage about 700 feet above bridge.
[b] Backwater from Seneca River.
[c] Stream badly choked by eel grass.

Mean daily gage height, in feet, of Onondaga Lake outlet at Long Branch, N. Y., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		6.80	4.40	2.85				
2		6.60	4.35			2.15		
3		6.60	4.25					2.40
4		6.50	4.15		2.60		2.10	
5		6.50		2.80				
6		6.30	4.00			2.10		
7		6.10	3.90					2.20
8			3.80		2.52			
9		5.90	3.95	2.65				
10		5.70	3.90			2.08	2.05	
11		5.60	3.80					
12		5.40		2.55	2.38			2.20
13		5.20	3.70			2.07		
14		5.00	3.60	2.50			2.00	
15			3.55		2.33			
16	7.50	5.00	3.55	2.72		2.06		
17	7.40	4.95	3.50					1.80
18	7.30	4.85	3.40		2.30			
19	7.40	4.80		2.65			1.90	
20	7.30	4.85	3.30			2.04		
21	7.10	4.90		2.50				
22	7.00		3.30					1.80
23	7.00	4.80		2.40	2.40	1.98		
24	6.90	4.80	3.15				2.20	
25	6.80	4.80						
26	6.80	4.80			2.28			
27	6.70	4.75	2.95			2.00		
28	6.70	4.70					2.10	1.80
29	6.80		2.90					
30	6.80	4.50			2.20	2.05		
31		4.50					2.50	

ONEIDA LAKE, NEW YORK.

Oneida Lake affords a large evaporation surface in summer. In winter, however, the evaporation rate is greatly reduced by freezing of the lake surface. At the same time the precipitation on the drainage basin to the north and east is chiefly held back as surface storage in the form of snow, this portion of the area lying in the region of maximum snowfall of the State, the depth of accumulated snow aggregating sometimes several feet in the woodlands and having a water equivalent of from 2 to 3 inches per foot of densely compacted snow.

The following table shows the date of opening and closing of Oneida Lake by ice at Constantia, N. Y., the data up to 1896 having been collected for the United States Deep Waterways Commission by William Pierson Judson, C. E.:

Table showing dates of opening and closing of Oneida Lake by ice.

Year.	Opened.	Closed.	Year.	Opened.	Closed.
1845	.....	Dec. 15	1875	Apr. 2	Dec. 24
1846	Apr. 3	Dec. 8	1876	Mar. 27	Dec. 15
1847	Apr. 10	Dec. 28	1877	Apr. 3	Dec. 19
1848	Apr. 1	Dec. 25	1878	Apr. 1	Dec. 3
1849	Apr. 12	Dec. 14	1879	Apr. 7	Dec. 25
1850	Apr. 9	Dec. 22	1880	Apr. 1	Dec. 16
1851	Apr. 15	.....	1881	Apr. 25	Dec. 3
1852	.....	Feb. 10	1882	Apr. 2	Dec. 15
1852	Apr. 3	Dec. 13	1883	Apr. 6	Dec. 24
1853	Mar. 28	Dec. 24	1884	Apr. 2	Dec. 6
1854	Apr. 4	Dec. 3	1885	Apr. 3	Dec. 7
1855	Apr. 15	Dec. 17	1886	Apr. 2	Dec. 13
1856	Apr. 5	Dec. 25	1887	Apr. 1	Dec. 25
1857	Apr. 2	Dec. 16	1888	Apr. 5	Dec. 13
1858	Apr. 8	Dec. 3	1889	Apr. 3	Dec. 25
1859	Apr. 6	Dec. 17	1890	Apr. 6	Dec. 22
1860	Apr. 1	Dec. 20	1891	Apr. 25	Dec. 16
1861	Apr. 7	Dec. 15	1892	Apr. 4	Dec. 11
1862	Apr. 3	Dec. 4	1893	Apr. 2	Dec. 24
1863	Apr. 9	Dec. 20	1894	Apr. 6	Dec. 17
1864	Apr. 2	Dec. 13	1895	Apr. 19	Dec. 28
1865	Mar. 26	Dec. 5	1896	Apr. 19	.....
1866	Mar. 30	Dec. 11	1897	Mar. 30	Dec. 18
1867	Mar. 24	Dec. 25	1898	Mar. 17	Dec. 12
1868	Apr. 2	Dec. 10	1899	Apr. 20	Dec. 28
1869	Apr. 5	Dec. 25	1900	Apr. 18	Dec. 25
1870	Apr. 1	Dec. 16	1901	Apr. 14	Dec. 30
1871	Apr. 3	Dec. 2	1902	Mar. 28	Dec. 24
1872	Apr. 12	Dec. 24	1903	Mar. 21	Dec. 22
1873	Apr. 1	Dec. 3	1904	Mar. 15	.....
1874	Apr. 6	Dec. 13			

ONEIDA RIVER NEAR EUCLID, N. Y.

Oneida Lake has a water-surface area of 80 square miles and lies at elevation 370 feet above tide. The drainage basin within a radius of 10 miles to the south and west is relatively flat, with numerous marshy tracts. The lake receives, through Chittenango and Oneida creeks, drainage from an extensive area of the central New York plateau, and through Wood and Fish creeks on the east, drainage from a portion of the west slope of the plateau bordering the Adirondack Mountains. On the north the drainage area is less extensive and the inflowing streams are small.

The outflow from the lake through Oneida River, 16 miles in length, joins Seneca River at Three River Point, forming Oswego River, which is tributary to Lake Ontario. Observations of the stream stage have been taken by measuring down to water surface each morning and evening from a reference point on the bulkhead coping of the lock at the Oak Orchard State dam 0.4 mile above Schroeppel's bridge. Flashboards placed on the dam during the low-water season of 1904 have modified the stage during the period when they are in use.

A calibration curve for the cross section of the stream at Schroeppel's bridge has been obtained by current-meter measurements. The gage readings have been taken above the dam, as stated, to avoid backwater from ice or other causes as far as possible.

The gaging station is 7 miles upstream from Three River Point. The observations are taken by Arthur McArthur. The drainage area above the gaging station has been taken provisionally at 1,400 square miles.[a]

Above a certain stage the dam becomes submerged and the discharge modified. A special rating table deduced from measurements made during the period of submergence has been used to calculate the discharge in the high-water season of 1904. Allowance is made for opening of lock paddles in winter.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

[a] From Bien's Atlas of New York. A portion of the drainage area is shown on the Syracuse, Chittenango, Oneida, Oriskany, Morrisville, Cazenovia, and Tully sheets of the United States Geological Survey Topographic Atlas. For additional data concerning Oneida River see report on stream gagings, contained in Supplement, Report of State Engineer and Surveyor for New York, 1902, pp. 82–84.

Discharge measurements of Oneida River near Euclid, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	C. C. Covert	2,070	4.06	0.87	8,408
May 5	do	1,920	4.13	1.10	7,959
May 12	do	1,711	3.90	1.92	6,683
May 18	do	1,575	3.67	2.40	5,792
May 28	C. A. Swancott	578	6.70	3.00	3,880
June 25	C. C. Covert	1,003	2.19	4.20	2,199
July 29	C. A. Swancott	839	1.43	4.15	1,200
September 1	do	829	1.38	4.22	1,143
November 19	Covert and Weeks	852	1.53	4.60	1,307

Mean daily discharge, in second-feet, of Oneida River near Euclid, N. Y., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,450	2,300	3,420	11,710	8,380	3,970	1,780	1,300	1,300	940	1,920	1,240
2	2,540	2,230	3,320	10,000	8,240	3,770	1,640	1,240	1,240	940	1,920	1,300
3	2,710	2,230	2,960	9,730	8,170	3,460	1,640	1,190	1,240	990	1,850	1,250
4	2,630	2,370	3,140	9,930	8,170	3,260	1,640	1,190	1,240	1,040	1,780	1,350
5	2,540	2,540	3,320	10,000	8,040	3,260	1,640	1,090	1,190	1,090	1,850	1,410
6	2,540	2,540	3,520	9,930	7,900	2,980	1,640	1,090	1,190	1,240	1,710	1,350
7	2,540	2,710	4,130	9,860	7,750	2,980	1,640	1,140	1,190	1,300	1,780	1,300
8	2,370	3,140	4,900	9,800	7,610	2,890	1,640	1,190	1,190	1,300	1,780	1,250
9	2,300	3,420	6,460	9,600	7,480	3,060	1,640	1,190	1,190	1,300	1,780	1,250
10	2,230	3,620	6,330	9,930	7,200	2,980	1,570	1,190	1,190	1,400	1,710	1,250
11	2,080	3,880	6,330	10,080	6,810	2,890	1,450	1,090	1,190	1,300	1,500	1,250
12	2,010	3,830	6,210	10,200	6,550	2,890	1,450	1,090	1,190	1,710	1,500	1,250
13	1,940	3,830	5,960	10,150	6,300	2,800	1,350	1,090	1,190	1,640	1,350	1,250
14	1,900	3,830	5,840	10,000	6,050	2,720	1,300	1,090	1,190	1,500	1,350	1,300
15	1,800	3,980	5,600	9,930	5,800	2,550	1,300	1,090	1,140	1,500	1,450	1,350
16	1,660	4,130	5,470	9,800	5,440	2,380	1,400	1,090	1,090	1,500	1,400	1,350
17	1,870	4,330	5,240	9,600	5,560	2,380	1,400	1,040	1,090	1,500	1,400	1,350
18	1,940	4,080	5,130	9,600	5,440	2,290	1,400	1,040	1,090	1,500	1,570	1,300
19	2,080	4,080	5,130	9,800	5,310	2,290	1,350	1,140	1,090	1,500	1,450	1,250
20	2,230	3,830	4,790	9,160	4,970	2,290	1,300	1,240	1,140	1,640	1,400	1,200
21	2,080	3,830	4,680	8,920	4,850	2,140	1,300	1,240	1,190	1,500	1,350	1,150
22	1,870	3,720	4,790	8,780	4,740	2,070	1,300	1,240	1,140	1,780	1,400	1,150
23	1,800	3,620	5,350	8,520	4,740	2,070	1,400	1,350	1,090	1,780	1,400	1,150
24	1,870	3,620	6,330	8,600	4,520	2,070	1,350	1,350	1,090	1,850	1,400	1,150
25	1,940	3,520	7,750	8,380	4,520	2,000	1,300	1,240	1,090	1,920	1,400	1,300
26	2,080	3,420	9,020	8,320	4,290	1,920	1,300	1,240	1,090	1,780	1,300	1,560
27	2,080	3,420	9,860	8,320	3,870	1,780	1,300	1,350	1,090	1,920	1,300	1,300
28	2,160	3,420	9,800	8,380	3,970	1,920	1,300	1,350	1,090	1,920	1,300	1,610
29	2,230	3,420	9,730	8,600	3,870	1,920	1,300	1,350	1,090	1,920	1,400	1,800
30	2,370	.....	9,730	8,600	3,870	1,780	1,300	1,350	1,040	1,920	1,350	1,800
31	2,300	.....	9,730	.....	3,870	.....	1,300	1,450	.....	1,920	.....	1,900

[a] January 1 to February 22 stream partly frozen above dam, but not sufficient to modify the flow.

Estimated monthly discharge of Oneida River near Euclid, N. Y., for 1904.

[Drainage area, 1,313 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,710	1,660	2,162	1.64	1.89
February	4,330	2,230	3,403	2.59	2.80
March	9,860	2,960	5,934	4.52	5.20
April	10,200	8,320	9,474	7.22	8.06
May	8,380	3,870	5,944	4.53	5.22
June	3,970	1,780	2,592	1.97	2.20
July	1,780	1,300	1,439	1.10	1.27
August	1,450	1,040	1,204	.917	1.06
September	1,300	1,040	1,152	.877	.978
October	1,920	940	1,517	1.16	1.34
November	1,920	1,300	1,535	1.17	1.30
December	1,900	1,150	1,344	1.02	1.18
The year	10,200	940	3,142	2.39	32.50

CHITTENANGO CREEK AT CHITTENANGO, N. Y.

A current-meter gaging station was established at Main Street Bridge in Chittenango village May 22, 1901. The stream at this point is entrained between parallel walls, affording a channel 50 feet wide, over which the bridge passes at a single span. The bridge stands at an angle to the thread of the stream, and has a span between abutments of 57 feet. The gage board is secured in a vertical position to the right abutment on the upstream side, and reads decimally from zero to 8 feet. The stage of the stream is observed twice daily by Bessie M. Kellogg. The bench mark is on the upstream corner of the coping of the right-hand bridge abutment.

Elevation bench mark 100.00
Elevation gage zero 91.77

The gaging station is one-half mile above the State dam diverting water for the supply of the summit level of Erie Canal. The flow of Chittenango Creek above Chittenango is regulated by storage in Cazenovia Lake and Erieville reservoir.[a]

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Erieville reservoir.

Tributary watershed	square miles	5.4
Storage capacity	cubic feet	318,424,000
Water surface	acres	340

[a] Data below from New York Barge Canal Report, 1900.

Drainage areas of Chittenango Creek.[a]

Location.	Area.
	Sq. miles.
Above Chittenango Falls	63.0
Above gaging station	78.9
Above mouth	326.3

[a] From Morrisville, Oneida, Cazenovia, Chittenango, Tully, and Syracuse sheets of the United States Geological Survey Topographic Atlas.

Discharge measurements of Chittenango Creek at Chittenango, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 30	C. A. Swancott	97	0.70	1.38	55
July 28	do	104	.82	1.50	70
August 31	do	95	.73	1.48	70
October 1	A. M. Evans	96	.58	1.34	56

Mean daily gage height, in feet, of Chittenango Creek at Chittenango, N. Y., for 1904.

Day.	Jan.	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[b]1.80	1.90	1.70	3.20	2.20	1.50	1.48	1.45	1.45	1.40	1.40	1.55
2	1.80	1.90	1.70	3.10	2.20	1.45	1.55	1.50	1.35	1.40	1.40	1.30
3	1.80	1.90	2.20	2.60	2.00	1.45	1.25	1.75	1.38	1.40	1.30	1.35
4	1.80	2.00	2.25	2.40	2.00	1.45	1.20	1.50	1.45	1.40	1.35	1.35
5	1.80	1.90	1.95	2.45	1.90	1.50	1.32	1.55	1.40	1.45	1.35	1.30
6	1.80	1.95	1.92	2.55	1.85	1.45	1.48	1.52	1.45	1.45	1.40	1.30
7	[c]1.80	3.03	2.90	2.60	1.80	1.40	1.40	1.50	1.40	1.30	1.40	1.20
8	1.80	3.15	3.45	2.65	1.80	1.40	1.40	1.48	1.40	1.30	1.35	1.10
9	1.80	2.65	2.75	2.85	1.80	1.95	1.30	1.40	1.40	1.30	1.40	1.25
10	1.80	2.40	2.45	3.30	1.80	1.70	1.30	1.40	1.40	1.30	1.30	1.40
11	1.70	2.35	2.30	2.80	1.70	1.50	1.30	1.48	1.40	1.40	1.30	1.20
12	1.70	2.30	2.15	2.80	1.65	1.50	1.32	1.42	1.32	1.40	1.35	1.20
13	1.70	2.20	2.00	2.70	1.60	1.50	1.48	1.35	1.30	1.40	1.25	1.00
14	[d]1.70	2.20	1.95	2.60	1.52	1.50	1.45	1.52	1.38	1.30	1.35	1.00
15	1.70	2.00	1.90	2.55	2.00	1.50	1.35	1.45	1.48	1.30	1.25	.90
16	1.70	2.00	1.90	2.30	1.95	1.50	1.45	1.50	1.50	.....	1.45	.85
17	[c]1.70	2.00	2.00	2.30	1.85	1.50	1.50	1.50	1.45	.....	1.45	.85
18	1.70	1.90	2.10	2.20	1.75	1.50	1.42	1.62	1.40	.....	1.45	.80
19	1.70	1.85	2.15	2.20	1.70	1.40	1.32	1.65	1.40	.....	1.40	.90
20	1.70	1.80	2.10	2.20	1.75	1.40	1.48	1.90	1.40	.....	1.45	.95
21	1.70	1.75	2.10	2.30	1.70	1.40	1.35	1.75	1.50	.....	1.50	.95
22	1.90	2.00	2.70	2.32	1.60	1.40	1.35	1.80	1.40	.....	1.50	.90
23	[d]2.90	1.85	3.60	2.45	1.60	1.40	1.38	2.15	1.40	1.40	1.50	1.35
24	2.45	1.75	3.40	2.45	1.50	1.40	1.55	1.75	1.40	1.50	1.45	1.75
25	2.20	1.80	3.80	2.08	1.50	1.30	1.58	1.55	1.40	1.40	1.65	1.55
26	2.20	1.80	4.80	2.30	1.50	1.30	1.50	1.48	1.45	1.40	1.65	1.00
27	2.20	1.82	3.40	2.45	1.95	1.40	1.55	1.40	1.45	1.30	1.55	1.45
28	2.10	1.80	2.85	2.65	1.75	1.42	1.55	1.45	1.40	1.25	1.55	2.65
29	2.00	1.80	2.80	2.55	1.55	1.48	1.65	1.42	1.70	1.30	1.55	3.00
30	2.00	.....	2.80	2.20	1.55	1.52	1.52	1.45	1.65	1.50	1.50	2.00
31	1.95	.....	2.60	.....	1.60	.....	1.50	1.45	.....	1.40	.....	1.80

[a] During the most of February the creek was frozen part way across.
[b] Anchor ice.
[c] Stream completely frozen over.
[d] Stream open.

NOTE.—During the frozen season the gage was read to the water surface in hole cut in ice.

Rating table for Chittenango Creek at Chittenango, N. Y., from December 16, 1901, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	16	2.20	180	3.40	728	4.50	1,500
1.10	22	2.30	210	3.50	786	4.60	1,590
1.20	29	2.40	242	3.60	846	4.70	1,680
1.30	36	2.50	276	3.70	906	4.80	1,780
1.40	45	2.60	318	3.80	968	4.90	1,870
1.50	54	2.70	359	3.90	1,030	5.00	1,970
1.60	66	2.80	405	4.00	1,100	5.20	2,190
1.70	78	2.90	454	4.10	1,170	5.40	2,410
1.80	93	3.00	504	4.20	1,240	5.60	2.640
1.90	111	3.10	558	4.30	1,320	5.80	2,900
2.00	130	3.20	613	4.40	1,410	6.00	3,160
2.10	155	3.30	669				

The above table is applicable only for open-channel conditions. It is based upon 29 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.4 feet and 3 feet. Above gage height 3 feet the rating curve is based on 1 measurement at 3.8 feet. The table has been extended beyond these limits by means of logarithmic section paper.

Estimated monthly discharge of Chittenango Creek at Chittenango, N. Y., for 1904.

[Drainage area, 79 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January					
February					
March	1,780	78	361	4.57	5.27
April	669	150	305	3.86	4.31
May	180	54	91.5	1.16	1.34
June	120	36	52.4	.663	.740
July	63	28	48.0	.608	.701
August	168	45	62.7	.794	.915
September	78	36	48.0	.608	.678
October [a]	54	32	42.6	.539	.621
November	72	32	48.0	.608	.678
December	504	9	51.8	.656	.756

[a] No record October 16–22. Mean for actual number of days observed used as mean for entire month.

NOTE.—For ice conditions, see footnote to daily gage heights.

Cazenovia Lake.

Tributary watershed	square miles..	8.7
Storage capacity	cubic feet..	206,997,000
Water surface	square miles..	1.7

The drainage basin is deeply rolling, mostly cleared, and has a heavy impervious soil with extensive sodded meadow areas. The soil is underlaid by shale rock, often outcropping and affording numerous springs. The stream tributaries are somewhat sparse, marsh and swamp areas are very limited, with the exception of the Nelson Swamp, about 2 square miles in area.

Cazenovia Lake is located at an elevation of 1,190 feet. From its outlet to the foot of the plateau at Erie Canal crossing, the stream descends 770 feet; the distance, following the general trend of the valley, is 11 miles. The freshet of December 15, 1901, changed the cross section of the stream at the gaging station. Separate rating curves have been prepared for the periods preceding and following that date.[a]

SALMON RIVER NEAR PULASKI, N. Y.

A current-meter gaging station was established at Fox Bridge September 5, 1900. The original gage was a vertical board scale attached to the upstream end of the center pier, having its zero mark at elevation 88.41 feet, the top of the capstone of the central pier, upstream end, being used as a bench mark, with arbitrary elevation 100.00.

This gage was carried away by ice in the winter of 1901–2, and was replaced July 23, 1902, by a standard chain and weight gage, having its datum at elevation 87.21 feet.

The gage readings have been taken twice each day by S. J. Fox, and have been continued throughout winter and summer, the winter readings being obtained by observing the height to which the water rose in a hole in the ice underneath the gage. Owing to the obstruction of the river channel by ice the discharge for the winter period has not been deduced.

The gaging bridge consists of two spans 183.5 feet between abutments. The stream bed is of gravel and cobble, relatively flat and shallow. There are also two small overflow channels and a flood plain at an average elevation at the highway of 95 feet; the discharge through these is included in the high-water measurements.

The drainage basin above the gaging station is rolling and very sandy, rock lying near the surface in the upper regions of the watershed, in which locality there are also extensive areas of original forest.

The drainage area at the gaging station is provisionally taken at 264 square miles.

The drainage basin is located in a region of heavy snowfall; several feet of snow sometimes accumulating in the forest areas, and, by

[a] For results of gagings of Chittenango Creek at Bridgeport, just above the inflow to Oneida Lake, see Report on Stream Gagings, contained in Supplement, Report of State Engineer and Surveyor of New York, pp. 52–57.

gradually melting, feeding the stream during March and April. The current-meter measurements are made at 5-foot intervals across the stream from the downstream side of Fox Bridge, which is located about 2 miles upstream from Pulaski. The location of the gaging station is shown on the Pulaski sheet of the United States Geological Survey Topographic Atlas.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Salmon River near Pulaski, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
April 11	Covert and Swancott	1,055	5.73	6.45	6,053
September 23	A. M. Evans	259	.83	2.71	[a] 215
November 15	E. F. Weeks	248	1.23	2.82	305

[a] Discharge probably affected by brush in stream a few feet below gaging section.

Mean daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				4.70	5.80	3.28	3.72	2.70	2.60	4.38	3.28	2.85
2	[b] 4.10			5.15	6.35	3.18	3.90	2.70	2.60	3.75	3.20	2.82
3				5.00	6.15	3.08	4.08	2.70	2.58	3.48	3.20	2.88
4				4.55	6.05	3.05	3.40	2.70	3.90	3.30	3.10	2.82
5			[d] 5.60	4.50	6.00	3.05	3.32	2.60	3.38	3.15	3.05	2.92
6		5.70		4.60	5.75	3.10	3.50	2.70	3.10	3.28	3.05	2.95
7				4.82	5.45	3.05	3.25	2.65	2.95	3.30	3.00	3.05
8				5.10	5.45	3.00	3.05	2.60	2.80	3.18	3.00	2.98
9				6.24	5.22	3.62	2.85	2.50	2.78	3.10	2.92	3.08
10	4.30			7.08	4.85	3.70	2.75	2.50	2.75	3.65	2.92	3.05
11				6.12	4.32	3.28	2.80	2.48	2.70	4.95	2.88	[a]
12			5.80	5.48	3.95	3.05	2.88	2.45	2.68	4.65	2.88	.....
13		[d] 5.00		4.98	3.70	2.95	3.60	2.45	2.55	3.98	2.88	.....
14				4.60	3.60	2.88	3.40	2.45	2.90	3.62	2.85	.....
15				4.28	3.98	2.92	3.00	2.45	3.08	3.42	2.82	.....
16	[c] 4.35			4.08	4.90	3.10	2.85	2.42	2.98	3.30	2.82	.....
17				3.92	4.25	2.92	2.75	2.40	2.75	3.18	2.80	3.30
18				3.95	3.75	2.82	3.20	2.40	2.78	3.10	2.80	.....
19			[e] 4.80	4.05	3.62	2.75	3.20	2.40	2.70	3.10	2.78	.....
20		5.00		3.82	4.08	2.75	2.92	2.85	2.70	3.02	2.80	.....
21				3.80	4.15	2.82	2.72	5.75	2.72	3.42	2.82	.....
22				3.82	3.90	3.42	2.70	4.20	2.70	4.60	2.95	.....
23	5.00			4.20	3.62	3.42	2.72	4.10	2.70	4.05	2.80	.....
24				4.70	3.78	3.12	3.00	3.48	2.78	3.82	2.80	3.85
25				6.78	3.68	3.00	2.92	3.15	5.00	3.58	2.85	.....
26			[f] 7.40	6.27	3.80	3.00	2.80	3.15	4.55	3.68	2.85	.....
27		[g] 4.85		5.68	3.98	2.95	2.75	3.05	3.90	4.00	2.75	.....
28				5.95	4.00	2.80	2.72	2.88	3.48	3.75	2.80	4.70
29			7.20	6.35	3.60	2.78	2.95	2.80	3.55	3.58	2.80	4.30
30	[h] 4.80		5.10	6.05	3.38	2.98	3.00	2.68	5.25	3.50	2.80	3.95
31			4.45		3.35		2.78	2.70		3.38		3.90

[a] Stream frozen over January 16 to March 28 and December 4 to 31, inclusive. Readings taken weekly to water surface.
[b] Ice 18 inches thick at gage.
[c] Ice 22 inches thick at gage.
[d] Ice 28 inches thick at gage.
[e] Ice 20 inches thick at gage.
[f] River open; ice jam below the station.
[g] Ice 30 inches thick at gage.
[h] Ice 26 inches thick at gage.

Rating table for Salmon River near Pulaski, N. Y., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	110	3.60	781	4.70	2,140	5.80	4,490
2.50	144	3.70	865	4.80	2,300	5.90	4,780
2.60	181	3.80	965	4.90	2,470	6.00	5,100
2.70	218	3.90	1,060	5.00	2,640	6.20	5,770
2.80	265	4.00	1,170	5.10	2,840	6.40	6,530
2.90	312	4.10	1,300	5.20	3,020	6.60	7,340
3.00	364	4.20	1,420	5.30	3,240	6.80	8,190
3.10	422	4.30	1,450	5.40	3,460	7.00	9,070
3.20	480	4.40	1,680	5.50	3,700	7.20	10,000
3.30	550	4.50	1,830	5.60	3,950	7.40	11,000
3.40	620	4.60	1,980	5.70	4,200	7.60	12,060
3.50	697						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 2.45 feet and 3.25 feet. Above this point the curve is based on three measurements at gage height 6.3 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Salmon River near Pulaski, N. Y., for 1904.

[Drainage area, 264 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]					
February [a]					
March [a]					
April	9,420	965	3,175	12.03	13.42
May	6,340	585	2,143	8.13	9.37
June	865	241	411	1.56	1.74
July	4,260	218	443	1.68	1.94
August	4,350	110	430	1.63	1.88
September	3,130	162	581	2.20	2.46
October	2,550	378	874	3.31	3.82
November	532	241	317	1.20	1.34
December [a]					

[a] Stream frozen. Record not available.

BLACK RIVER NEAR FELTS MILLS, N. Y.

The gaging station is located at the dam of the Black River Traction Company, near the village of Felts Mills. The dam is situated 9 miles upstream from Watertown and 7 miles upstream from the old Huntingtonville gaging station on the same stream. The drainage area is estimated at 1,851 square miles, or 37.5 square miles less than that at Huntingtonville. The intervening area is mainly comprised in two small streams, Townsend and Rutland Hollow creeks.

The dam is of squared timber and has a slope on the upstream face of 2.88 horizontal to 1 vertical. The crest is protected by boiler plate, and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet in length. There are two additional sections on the right-hand side, one 14.1 feet long and the other 17.9 feet in length. A similarly constructed dam, 117 feet long at the left bank, serves as an auxiliary spillway and as a headrace wall.

The gage is attached vertically to a crib at the juncture of the main and auxiliary spillways, 12 feet upstream from the crest, and a correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula using coefficients derived from experiments of the United States Geological Survey for a dam of similar cross section. The dam was constructed in 1900, rests on limestone foundation, and is very nearly water-tight. The headrace is closed by a bulkhead, no water wheels having been installed.

Owing to continued discharge over dam to a considerable depth during the years 1903 and 1904, it has not been possible to obtain a new profile of the crest. The discharge has been calculated from the known elevations of the ends of the crest, and the results given are subject to revision. Settlement of the crest, if any has taken place, would have the effect of making the discharge at a given gage height greater than that given in the accompanying tables. The gage readings are taken twice daily, at 7 a. m. and 6 p. m., by George W. Kidder.

The regimen of Black River is controlled by storage on its larger tributaries, including Beaver River at Beaver, a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of Black River.

Water is diverted from Black River through Forestport feeder to supply the Black River canal at Boonville. A portion of this diversion flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through Black River canal and enters Erie canal at Rome. The amount of this diversion which takes place during the season of canal navigation is not continuously recorded.

Measurements made by the New York Barge Canal Survey in 1900

showed the following amounts of flow in the Black River canal south of the Forestport feeder:

Date.	Discharge.
	Second-feet.
August 31, 1900	197.4
September 24, 1900	242.2
November 7, 1900	254.2
December 1, 1900	181.2

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of Black River near Felts Mills, N. Y., 1902–1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1									975	1,520	3,900	2,600
2									1,070	1,470	3,130	2,210
3									1,320	1,580	2,860	2,080
4									1,270	1,270	2,210	4,990
5									1,120	804	1,750	4,430
6									975	1,370	1,690	2,860
7									590	1,970	1,690	3,000
8									1,320	1,970	1,750	2,660
9									1,470	2,150	1,690	2,470
10									1,470	1,860	1,580	2,280
11									2,340	1,220	1,520	1,860
12									1,970	1,320	1,580	1,370
13									1,580	1,470	4,590	1,420
14									1,120	2,080	5,070	1,470
15									1,420	2,410	5,240	1,320
16									1,320	2,080	3,970	1,580
17									1,270	1,690	3,130	590
18									1,220	1,640	2,730	2,340
19									1,170	1,420	2,660	3,400
20									932	1,800	2,860	3,200
21									676	1,970	2,340	3,620
22									1,170	2,210	1,920	4,200
23									1,020	1,750	1,750	5,820
24									761	2,080	2,800	6,500
25									847	1,640	2,280	5,640
26									1,020	1,690	1,920	5,240
27									804	1,970	2,080	4,270
28									1,020	2,340	2,730	3,620
29									1,220	1,320	3,970	3,130	3,200
30									1,120	1,580	4,750	2,280	3,000
31									932		4,830		2,800
1903.												
1	2,470	5,640	8,590	5,920	2,210	522	1,970	5,560	2,210	1,020	2,340	1,320
2	2,150	6,590	9,160	5,720	1,970	453	1,920	3,970	1,750	1,320	2,080	1,420
3	2,340	6,690	9,640	5,240	1,640	453	1,970	3,690	1,750	1,120	1,970	1,520
4	3,270	7,400	9,870	6,300	1,690	453	2,080	3,400	1,420	1,320	1,750	1,640
5	3,970	8,360	8,930	7,300	1,860	351	1,860	3,540	1,220	1,220	2,210	1,750
6	3,620	7,600	8,480	(a)	1,640	282	2,340	3,830	1,120	1,320	2,860	1,860
7	3,400	6,690	7,300	(a)	1,580	282	3,270	4,120	932	1,320	2,470	1,970
8	2,800	6,010	7,500	(a)	1,640	761	3,130	4,430	761	1,750	1,970	2,210
9	2,470	5,320	10,200	(a)	1,520	718	2,730	2,730	676	3,270	1,750	1,860

[a] Record not available.

Mean daily discharge, in second-feet, of Black River near Felts Mills, N. Y., etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
10	2,280	4,270	11,400	(a)	1,320	890	2,340	3,400	676	11,500	1,520	1,320
11	1,920	3,900	14,100	(a)	1,020	487	1,750	3,130	847	17,600	1,320	1,750
12	1,860	4,430	17,600	(a)	1,520	1,750	1,520	3,400	676	18,200	1,520	1,750
13	1,750	5,560	16,700	(a)	1,320	5,320	1,640	3,830	1,020	10,500	1,320	1,520
14	1,640	5,640	15,500	(a)	975	4,910	1,320	3,540	590	8,560	1,520	1,750
15	1,520	5,560	14,100	(a)	676	3,830	1,120	2,470	590	7,500	1,750	2,340
16	1,750	5,240	11,700	(a)	590	2,660	1,020	1,860	590	6,500	1,970	1,860
17	1,970	4,670	11,500	(a)	932	2,340	847	1,640	847	5,920	2,210	1,420
18	1,470	4,040	11,200	(a)	718	1,750	761	1,120	932	7,500	1,970	1,750
19	1,320	3,900	12,800	(a)	890	1,320	590	1,120	1,420	9,040	1,750	1,750
20	1,690	3,620	14,700	(a)	1,020	1,470	453	1,120	1,120	10,200	1,420	1,640
21	2,800	2,930	16,800	(a)	590	1,020	1,020	1,580	1,750	10,200	1,320	2,080
22	2,800	2,730	18,800	(a)	419	2,780	1,420	1,690	1,120	8,810	1,750	2,860
23	2,080	2,660	22,100	(a)	590	3,470	2,210	1,750	932	6,500	2,080	3,400
24	2,210	2,470	(b)	(a)	159	3,400	3,000	1,520	2,120	4,750	2,600	3,970
25	2,660	2,470	(b)	(a)	522	3,470	3,400	1,860	847	4,430	2,080	4,270
26	2,800	2,410	(b)	1,580	676	3,970	3,000	2,210	590	4,270	1,970	3,400
27	2,800	2,540	21,400	2,030	590	3,760	2,600	2,600	676	3,690	1,750	3,080
28	2,800	3,470	17,300	2,540	453	3,000	2,210	2,470	676	3,400	1,420	3,270
29	3,690	.....	13,300	2,150	453	2,340	2,470	2,340	1,320	3,000	1,220	3,270
30	4,590	.....	8,360	1,580	385	1,970	5,070	2,210	1,220	2,730	1,520	2,860
31	6,010	.....	6,690	.....	385	.....	6,500	2,340	.....	2,470	.....	2,600
1904.												
1	2,470	932	1,640	9,990	(c)	3,310	1,620	1,620	736	7,760	2,530	1,280
2	2,210	1,220	1,860	9,520	(c)	2,900	1,410	1,510	513	7,760	2,470	1,380
3	1,970	1,640	2,470	9,040	(c)	2,190	2,010	1,160	907	7,250	2,210	1,480
4	2,210	1,860	3,400	9,750	(c)	2,120	2,120	1,110	1,280	6,360	2,470	616
5	1,860	2,470	4,270	10,200	(c)	1,960	1,960	1,310	2,340	5,130	2,400	907
6	1,750	4,590	4,750	9,750	(c)	2,010	2,010	1,160	2,140	4,030	2,340	1,080
7	1,420	6,890	5,070	9,040	(c)	2,640	2,190	527	1,380	3,460	2,140	1,280
8	1,320	6,300	4,270	8,360	(c)	2,840	1,900	1,160	1,040	2,990	2,090	992
9	1,120	5,720	3,690	8,590	(c)	3,800	1,620	1,860	1,180	2,530	1,750	1,040
10	1,320	5,400	3,270	14,700	(c)	4,550	887	1,160	907	2,400	1,580	1,040
11	1,640	5,070	3,690	18,200	(c)	5,280	1,110	1,210	907	3,890	1,580	1,280
12	1,970	4,750	3,270	19,200	(c)	5,030	1,160	887	736	5,300	1,580	1,530
13	1,520	4,430	3,540	15,300	(c)	4,160	1,260	596	693	5,780	1,380	1,380
14	847	4,120	3,000	13,100	(c)	3,040	1,510	493	1,750	5,300	1,640	1,480
15	676	3,830	2,470	11,000	3,800	2,320	1,460	801	693	4,810	1,580	1,580
16	590	3,270	2,730	9,040	5,110	1,680	1,260	1,310	1,180	3,190	1,700	1,480
17	590	3,000	2,600	7,500	5,360	1,730	1,160	1,020	1,430	2,790	1,580	1,700
18	590	2,860	2,210	7,090	5,080	1,460	1,460	887	821	2,140	1,330	1,700
19	761	2,210	1,640	6,800	4,240	1,110	3,730	673	693	1,810	1,640	1,530
20	761	1,320	2,080	5,720	4,310	1,260	2,840	930	992	1,810	1,040	1,580
21	847	1,220	3,000	5,240	5,110	1,110	1,560	3,730	1,860	2,030	1,480	1,480
22	1,320	1,520	3,970	5,070	5,190	1,020	887	5,280	2,660	5,130	1,810	1,580
23	2,470	1,860	5,720	5,400	4,790	2,010	844	5,520	2,400	5,460	1,700	1,430
24	2,730	2,340	7,090	5,720	3,730	2,580	844	5,030	1,700	5,620	1,580	1,430
25	1,970	2,470	7,920	7,920	3,510	2,120	1,410	3,870	3,130	5,980	1,700	1,480
26	1,750	1,860	12,000	9,520	3,730	1,680	1,680	2,840	5,620	5,620	1,580	1,640
27	1,520	1,520	13,300	11,500	3,730	1,210	1,360	2,120	6,360	5,130	821	1,580
28	1,220	1,320	13,300	13,100	4,240	758	1,060	2,120	6,360	4,490	1,130	1,750
29	1,120	1,220	12,800	14,400	4,080	562	1,790	1,460	5,880	4,080	1,580	1,980
30	1,120	.....	11,500	15,500	3,870	1,360	1,900	1,210	6,950	2,920	1,280	3,530
31	932	.....	10,200	.....	3,660	.....	1,160	1,060	.....	2,660	.....	1,480

a Record not available. b Above rating table. c No record.

Estimated monthly discharge of Black River near Felts Mills, N. Y., 1902–1904.

[Drainage area, 1,851 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
September	2,340	590	1,205	0.651	0.726
October	4,830	804	2,009	1.09	1.26
November	5,240	1,520	2,628	1.42	1.58
December	6,500	590	3,098	1.67	1.92
1903.					
January	6,010	1,320	2,610	1.41	1.63
February	8,360	2,410	4,743	2.56	2.66
March, 28 days	(a)	6,690	12,700	6.86	7.14
April, 10 days	(b)	.....	4,036	2.18	.811
May	2,210	159	1,031	.557	.642
June	5,320	282	2,002	1.08	1.20
July	6,500	453	2,178	1.18	1.36
August	5,560	1,120	2,725	1.47	1.70
September	2,210	590	1,047	.566	.632
October	18,200	1,020	5,837	3.15	3.63
November	2,860	1,220	1,846	.997	1.11
December	4,270	1,320	2,238	1.21	1.40
1904.					
January	2,730	590	1,438	.777	.896
February	6,890	932	3,007	1.62	1.75
March	13,300	1,640	5,249	2.84	3.27
April	19,200	5,070	10,160	5.49	6.12
May 15–31	5,360	3,510	4,323	2.34	1.48
June	5,280	562	2,327	1.26	1.41
July	3,730	844	1,586	.857	.988
August	5,520	493	1,779	.961	1.11
September	6,950	513	2,174	1.17	1.30
October	7,760	1,810	4,373	2.36	2.71
November	2,530	821	1,723	.931	1.04
December	3,530	616	1,474	.796	.918

a Above rating table.
b Record not available April 6–25, inclusive.

MOOSE RIVER AT MOOSE RIVER, N. Y.

Moose River drainage basin lies mainly in Herkimer and Hamilton counties, N. Y. The stream is tributary to Black River at Lyons Falls. The gaging station was established June 5, 1900. Two readings of the stream stage are taken daily on a graduated board scale attached to posts on the left bank of the stream at Moose River village, the gage comprising a high-water and a low-water section. The observer is Chris Hannan.

A cableway was erected at the gaging station in June, 1903, having a clear span of 269 feet, from which the current meter measurements listed below have been made in 1904. The bed of the stream is of cobble with occasional bowlders, the current smooth, depth fairly uniform. A short distance below occurs a fall. The stream is smooth above the gaging station to the foot of McKeever Dam, 2 miles upstream, but is divided by an island a short distance above the gage, which creates an ice jam during spring freshets. The gage was carried out by such an ice freshet February 28, 1903, and was replaced at a slightly different elevation. The bench mark is on top of a bowlder on the left stream bank 300 feet upstream from cableway.

Elevation bench mark, assumed	100.00
Elevation gage zero prior to February 28, 1903	84.64
Elevation gage zero after February 28, 1903	84.47

The flow for the spring months is controlled by lumbermen's dams, large volumes of water being turned into the stream when required for log driving.

The stream freezes over in winter, alternate layers of ice and snow or slush often forming in such manner as to prevent discharge measurements being made. During the ice season the gage is read once each week.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Moose River.[a]

Stream.	Location.	Area.
		Sq. miles.
South Branch Moose River	Above Indian River	67.2
Indian River	Above mouth	50.2
Total		117.4
Middle Branch Moose River	Above Old Forge	52.3
Moose River	Above Moose River gaging station	374.1
Do	Above mouth	439.6

[a] From U. S. Geol. Maps, East of 75th Meridian, remainder from Bien's Atlas of New York.

Discharge measurements of Moose River at Moose River, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 29	C. C. Covert	474	0.62	1.15	290
September 21	A. M. Evans	702	.92	2.21	648
October 22	Beebe and Swancott	1,408	2.25	5.39	3,162
October 23	C. A. Swancott	1,116	1.74	4.22	1,943
October 24	do	828	1.30	3.12	1,074

Mean daily gage height, in feet, of Moose River at Moose River, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	.....	.....	.....	6.20	2.35	1.60	1.40	0.80	4.85	2.15	1.65
2	1.80	.....	.....	3.60	6.95	2.35	2.20	1.50	1.20	4.05	2.55	1.65
3	1.80	.....	.....	.....	6.65	2.25	2.25	1.40	1.45	3.85	2.85	1.75
4	1.80	.....	.....	.....	6.50	1.95	2.35	1.35	2.75	3.60	2.85	1.80
5	1.90	.....	3.90	.....	6.10	1.95	2.45	1.25	2.20	3.35	2.85	1.65
6	1.90	2.60	.....	.....	5.85	2.95	2.65	1.35	1.70	3.25	2.55	1.50
7	1.85	.....	.....	.....	5.35	3.20	2.40	1.25	1.45	3.10	2.35	1.40
8	1.80	.....	.....	.....	5.20	2.95	2.05	1.20	1.35	2.60	2 55	1.30
9	1.80	.....	.....	4.60	4.75	4.05	1.85	1.15	1.20	2.25	2.50	1.50
10	1.85	.....	.....	6.15	4.25	5.40	1.50	1.10	1.10	2.25	2.55	1.75
11	1.80	.....	.....	5.70	3.75	4.20	1.35	1.00	.95	4.45	2.35	1.80
12	1.80	.....	4.40	5.00	3.20	3.45	1.25	.90	1.05	4.65	2.20	1.70
13	1.90	2.10	.....	4.45	3.05	2.75	1.25	.95	.95	3.90	2.25	1.60
14	1,90	.....	.....	4.05	2.85	2.60	1.15	1.15	1.00	3.50	2.30	1.65
15	1.90	.....	.....	3.85	2.75	2.45	1.15	1.40	1.35	2.90	2.20	1.65
16	2.05	.....	.....	3.80	4.10	2.05	1.05	1.50	1.90	2.45	2.05	1.60
17	2.10	.....	.....	3.70	3.90	1.85	.90	1.35	2.05	2.30	1.95	1.50
18	2.10	.....	.....	3.55	3.35	1.60	1.00	1.25	1.75	2.60	1.85	1.50
19	2.10	.....	3.60	3.35	3.10	1.50	.95	1.15	1.70	2.45	1.75	1.40
20	2.10	.....	.....	2.90	3.30	1.40	.85	1.85	2.35	2.25	1.80	1.50
21	2.10	.....	.....	2.70	3.25	1.75	.70	4.15	2.45	2.50	2.05	1.40
22	2.20	.....	.....	2.55	3.05	2.85	.80	3.50	2.30	5.55	2.05	1.50
23	2.40	.....	.....	2.80	2.75	3.05	.85	3.05	2.10	4.20	2.15	1.45
24	2.70	.....	.....	3.20	2.45	2.65	.95	2.65	2.25	3.40	2.15	1.40
25	2.95	.....	.....	5.45	2.70	2.25	1.25	1.85	5.10	2.90	2.00	1.45
26	2.95	.....	4.30	5.35	2.70	1.95	1.55	1.60	5.05	2.85	1.80	1.50
27	3.00	3.60	.....	5.20	3.15	1.65	1.65	1.35	4.15	2.85	1.65	1.85
28	2.80	.....	.....	5.70	3.25	1.35	1.65	1.15	3.85	2.60	1.65	2.30
29	2.75	.....	.....	6.35	3.20	1.10	1.65	1.00	3.65	2.20	1.90	2.85
30	2.70	.....	.....	6.50	2.50	1.25	1.60	.85	6.05	2.10	1.80	2.95
31	(a)	.....	.....	.....	2.40	.....	1.50	.80	.....	2.15	.....	3.05

a River frozen January 31 to April 8.

ST. LAWRENCE RIVER DRAINAGE BASIN.

St. Lawrence River receives the drainage from a number of New York streams having their headwaters in a northerly slope of the Adirondack region, where there are also numerous lakes and storage facilities.

Grass, Raquette, and St. Regis rivers lie within the United States. Salmon, Trout, Chateaugay, and English rivers cross the international boundary line and flow northerly into St. Lawrence River in Canada, as does also Richelieu River, the outlet of Lake Champlain.

St. Lawrence River tributaries in United States.

Stream.	Drainage area.
	Sq. miles.
Oswegatchie River	1,609
Grass River	637
Raquette River	1,219
St. Regis River	910
Little Salmon River [a]	103
Salmon River [a]	273
Trout River [b]	129
Chateaugay River [b]	199
English River [b]	53
Lake Champlain [b]	8,187

[a] Above junction near international boundary. [b] Above New York State line.

Chateaugay River has extensive surface storage in the Upper and Lower Chateaugay lakes lying on the north slope of the Adirondacks. A measurement of the ordinary spring discharge of this stream was made by the engineers of the United States Deep Waterways at Ormstown, April 19, 1899; discharge, 2,720 second-feet, or 13.6 second-feet per square mile.

English River rises near the international boundary, flows southeasterly in New York, then recrosses into Canada, draining an area above the crossing of the boundary line of 53 square miles. A measurement of the spring flow of this stream was made near the New York and Canada boundary line, April 26, 1899, by the engineers of the United States Deep Waterways, at which time the discharge was 392 second-feet.

St. Lawrence River drains, through Lake Champlain, an area of 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek.

Missisquoi River has a total drainage area of 860 square miles, of which 245 square miles lie in Canada. It has its headwaters in the highlands west of Lake Memphremagog, thence flows southerly through Canada and westerly through Vermont into Lake Champlain. The slopes as a rule are quite steep. The basin is very generally made up of farm lands, but considerable areas of forest are found at the head-

waters of all its tributaries. There is no great amount of lake or artificial storage. At many points water power is in use, but the storage at such power plants is invariably small.

Lamoille River drains a total area of 725 square miles. Its headwaters lie in the Green Mountain region in the northern part of Vermont; thence it flows in a general westerly direction into Lake Champlain. The basin includes considerable farm land, but extensive areas of forest occur at the headwaters, especially in the mountainous regions. As the slopes are steep, there is no great amount of natural or artificial storage. Water power is used at many points along the river.

Winooski River drains a total area of 995 square miles, all in Vermont. It has its headwaters in the Green Mountain district in the east-central part of the State; thence it flows generally northwesterly into Lake Champlain near Burlington. The basin is generally in farm lands, with considerable areas of forest in the headwaters. The storage, either natural or artificial, is insignificant.

Raquette River drains a long, narrow watershed extending from Hamilton County to St. Lawrence River. Above Piercefield the drainage basin broadens out, including a region interspersed with lakes and ponds and affording ample opportunities for storage development,[a] as shown by the following list of lakes:

Lake.	Elevation of water surface.	Surface area.	Drainage area.
	Feet.	*Sq. miles.*	*Sq. miles.*
Blue Mountain Lake[b]	1,788	3.9	39.3
Raquette Lake	1,762	8.3	93.9
Forked Lake	1,741	2.5	39.8
Long Lake	1,629	4.7	152.2
Big Tupper Lake	1,554	8.0	59.3

The headquarters of Raquette River are on an elevated plateau dotted with mountains and interspersed with lakes. The region is timbered, and underlaid with granitic gneiss of the Adirondack formation, the soil in the valleys being often sandy. Numerous marsh and swamp areas exist; many of these are on the watershed divide and feed streams flowing in opposite directions.[c]

[a] Described in report on a survey of upper Hudson and Raquette rivers, Farrand N. Benedict, 1872.

[b] Including Eagle and Utowana lakes.

[c] The upper drainage basin is shown on the Blue Mountain, Raquette Lake, Big Moose, and Canada Lake sheets of the United States Geological Survey Topographic Atlas. Drainage areas south of the 75th meridian have been taken from this map. Those on the north are from Bien's atlas of New York.

Drainage areas of Raquette River.

Location.	Area.	
	Point to point.	Total.
	Sq. miles.	*Sq. miles.*
Blue Mountain and Utowana lakes	.....	18.4
South inlet, above mouth	.....	32.7
Above Raquette Lake outlet	67.0	118.1
Above Forked Lake dam	55.2	173.3
Above outlet Long Lake	100.5	273.8
Above Raquette Pond dam	421.1	694.9
Above Hannawa Falls	257.9	952.7
Above Massena Springs	216.0	1,168.7
Above mouth	50.0	1,218.7

Otter Creek drains a total area of 925 square miles, all in Vermont. Its headwaters are in the southern part of the State, generally at a lower elevation than those of either of the three rivers mentioned above. It flows generally northerly through some of the best farm districts in Vermont. The slope of the river between Rutland and Middlebury is very small, while between Middlebury and the mouth it is greater. The slopes of the tributary streams are generally steep. Storage in the basin is insignificant. Considerable areas on the headwaters of the river are in forest.

The following pages give the results of data collected during 1904 in the St. Lawrence River drainage basin:

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

A gaging station was established at Eel Weir Bridge May 16, 1903. Observations of the stream stage are taken twice daily by Joseph H. La Rue. This stream has its source in a region of lakes and timbered swamps in the southern part of St. Lawrence County. The largest of the lakes is Cranberry Lake, which affords valuable storage to water power users on its outlet, East Branch of Oswegatchie River. The East and West branches flow in a general direction northwesterly. The two branches join near Talcville. From Gouverneur to Oxbow the river flows southwest. It then turns abruptly to the northeast. At Galilee it is joined by the outlet of Black Lake, and finally enters St. Lawrence River at Ogdensburg. The Eel Weir Bridge is located just below the junction of Oswegatchie River and Black Lake outlet. The channel is in rock and is partly artificial, rock underneath the bridge having been removed by blasting to increase the bridge opening.

A standard chain gage is attached to the iron work of the bridge on the upstream side of the right-hand span. The bench mark is a square chisel draft on the upstream side of the right-hand abutment.

Elevation assumed 100.00
Elevation of datum plane of gage 83.28

The bridge consists of two spans: Right-hand, 129.6; left-hand, 130.1, feet length, respectively.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Oswegatchie River. [a]

Stream.	Location.	Area.
		Sq. miles.
East Branch Oswegatchie River	Above mouth	358
West Branch Oswegatchie River	do	272
Oswegatchie River	Below junction of two branches	630
Do	Above Gouverneur	727
Do	Above Galilee	1,033
Indian River	Above Philadelphia	216
Black Lake watershed	Above Galilee	544
Oswegatchie River	Below Black Lake Junction	1,577
Do	Above Ogdensburg	1,609
Black Lake water surface		17.2
Cranberry Lake water surface		12.8

[a] From Bien's Atlas of New York State.

Discharge measurements of Oswegatchie River near Ogdensburg, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
April 8	Covert and Swancott	1,166	8.11	8.10	9,464
April 10	do	1,176	8.11	8.05	9,548
July 4	C. C. Covert	306	3.95	4.80	1,206
October 23	A. M. Evans	549	4.40	5.68	2,414
October 23	do	536	4.42	5.64	2,372

Mean daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.10	5.40	5.20	9.60	6.70	5.45	4.60	5.00	5.00	6.20	5.80	4.60
2	5.10	5.40	5.30	9.45	6.70	5.50	4.60	5.00	4.95	6.40	5.70	4.60
3	5.00	5.40	5.30	9.20	6.65	5.65	4.65	4.90	5.00	6.60	5.70	4.65
4	4.90	5.25	5.30	9.05	6.60	5.50	4.80	4.90	5.00	6.60	5.60	4.70
5	4.90	5.10	5.40	8.65	6.50	5.50	4.80	4.90	5.00	6.60	5.50	4.70
6	4.80	5.00	5.45	8.30	6.40	5.50	4.80	4.90	5.20	6.45	5.55	4.70
7	4.65	5.00	5.55	8.20	6.35	5.40	4.80	4.80	5.35	6.30	5.60	4.65
8	4.60	5.00	6.05	8.00	6.25	5.40	5.00	4.80	5.30	6.05	5.50	4.60
9	4.60	5.00	6.70	7.90	6.10	5.30	5.20	4.80	5.20	6.15	5.40	4.60
10	4.60	5.00	7.40	7.95	6.05	5.25	5.15	4.75	5.10	6.30	5.40	4.60
11	4.65	5.15	7.35	7.95	5.95	5.20	5.00	4.70	5.10	5.65	5.30	4.60
12	4.70	5.35	7.50	8.05	5.55	5.05	4.80	4.70	5.10	5.50	5.45	4.65
13	4.70	5.30	7.20	7.90	5.50	5.00	4.80	4.65	5.05	5.60	5.00	4.65
14	4.70	5.30	7.30	7.90	5.50	5.00	4.80	4.65	4.90	5.60	4.80	4.65
15	4.70	5.20	7.10	7.65	5.50	5.00	4.80	4.60	4.90	5.55	4.80	4.65
16	4.70	5.20	6.85	7.40	5.45	4.80	4.70	4.60	4.90	5.50	4.80	4.70
17	4.70	5.20	6.60	7.30	5.30	4.70	4.70	4.60	4.90	5.50	4.80	4.60
18	4.70	5.20	6.25	7.10	5.30	4.70	4.75	4.60	4.90	5.45	4.75	4.60
19	4.70	5.20	5.95	6.85	5.30	4.70	4.80	4.60	4.90	5.40	4.70	4.60
20	4.70	5.20	5.80	6.45	5.60	4.70	4.80	4.50	4.90	5.40	4.70	4.50
21	4.65	5.20	5.85	6.40	5.85	4.70	4.80	4.50	4.95	5.50	4.75	4.50
22	4.70	5.20	5.60	6.30	6.10	4.60	4.80	4.50	5.00	5.55	4.70	4.50
23	4.70	5.15	5.90	6.35	6.05	4.60	4.80	4.50	5.00	5.45	4.70	4.50
24	4.85	5.25	6.65	6.40	6.00	4.65	4.85	4.65	5.05	5.55	4.70	4.50
25	5.25	5.80	7.20	6.40	6.00	4.70	5.00	4.85	4.90	5.60	4.70	4.50
26	5.80	5.30	8.25	6.30	5.95	4.70	5.05	5.00	4.90	5.60	4.70	4.50
27	6.10	5.20	9.15	6.25	5.85	4.65	5.10	5.10	5.10	5.70	4.70	4.60
28	6.15	5.20	9.60	6.25	5.60	4.70	5.10	5.15	5.45	5.70	4.70	4.70
29	5.90	5.20	9.95	6.50	5.50	4.70	5.20	5.10	5.55	5.80	4.65	4.80
30	5.70	.....	9.90	6.60	5.50	4.65	5.10	5.10	6.10	5.70	4.60	5.15
31	5.45	.....	9.65	.....	5.40	.....	5.00	5.10	.....	6.75	.....	5.10

NOTE.—The river seldom freezes on account of the swiftness of its current.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

Observations at the dam of the Hannawa Falls Power Company on Raquette River were taken from September 31, 1902, to March 31, 1903. The discharge has not been computed. A gaging station was established at Massena Springs highway bridge on Raquette River September 21, 1903. Observations were continued until October 17, 1903, when the station was temporarily abandoned. It was resumed 1904. The gage is a vertical scale attached to the right abutment on the upstream side of the bridge. The bench mark is a cross painted on the outside downstream corner of the foundation adjacent to the sulphur springs. Its elevation is 12.21 feet above gage datum. The bridge has a single span of 167.5 feet. The current is swift and uniform. The banks are not subject to overflow. The channel is straight for 300 feet above and 1,000 feet below the bridge. The headwaters of Raquette River are on an elevated plateau dotted with mountains interspersed with lakes. The region is timbered, but

numerous marsh and swamp areas exist. Many of these are on the divide and feed streams flowing in opposite directions. Raquette River drains a long, narrow basin extending from Hamilton County to St. Lawrence River. Above Piercefield the drainage basin broadens out, including a region containing many lakes and ponds and affording ample opportunities for storage development, as shown by the following list of lakes.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 9	C. C. Covert	1,097	3.69	5.15	4,052
July 2	do	449	2.34	1.60	1,050
July 3	do	484	2.39	1.85	1,153
August 19	do	375	1.87	1.18	702
August 21	do	340	1.97	.75	670
August 22	do	177	1.27	.10	226
August 23	do	302	1.69	.72	511
August 26	do	451	2.08	1.50	937
August 27	do	434	1.96	1.40	848
October 20	A. M. Evans	719	2.92	2.86	2,102

Mean daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.20	5.80	1.90	0.60	1.00	4.05	3.95	2.60
2	.....	5.10	5.50	1.90	.55	1.05	3.80	4.55	2.90
3	.....	5.10	5.45	1.70	.60	1.25	3.85	4.30	2.90
4	.....	4.85	5.25	2.40	.60	1.35	3.60	4.15	2.55
5	.....	4.70	5.10	2.85	.35	2.35	3.85	3.95	1.85
6	.....	4.85	4.90	2.60	.55	2.25	3.80	3.80	2.65
7	.....	4.50	4.70	2.20	.40	1.45	3.60	3.65	3.20
8	.....	5.80	4.50	2.30	.35	1.40	3.40	3.30	3.30
9	5.25	6.20	3.95	2.00	.30	1.30	3.30	3.40	3.30
10	6.50	6.25	3.55	1.15	.30	1.30	3.25	3.25	[a]3.30
11	6.15	6.00	3.05	1.65	.45	1.60	3.25	3.10	3.30
12	6.75	5.70	3.10	2.20	.75	1.45	3.45	2.90	3.30
13	6.20	5.35	3.10	2.90	.60	1.45	3.60	2.75	3.40
14	5.85	5.45	3.40	2.65	1.10	1.75	3.50	2.60	3.40
15	5.30	5.10	3.60	1.50	1.30	1.50	3.20	2.35	3.40
16	5.20	5.35	3.30	1.90	1.15	1.15	3.05	2.30	3.30
17	5.10	5.55	2.90	.75	1.15	1.25	3.15	2.55	3.30
18	5.10	5.75	3.10	.90	.85	1.45	2.90	3.15	3.20
19	5.20	5.75	4.10	1.10	1.30	1.45	2.95	2.75	3.20
20	4.90	5.55	3.90	1.25	1.35	1.55	2.90	1.75	3.10
21	5.00	5.30	3.40	1.75	1.40	1.70	2.85	2.00	3.05
22	5.15	5.05	3.35	1.20	.35	1.60	2.95	2.05	3.00
23	6.10	5.10	3.35	.90	.85	1.25	3.10	1.90	3.00
24	4.10	4.50	3.25	.55	1.05	1.05	3.40	1.90	2.95
25	5.20	4.75	2.65	.30	1.38	1.20	3.30	2.10	2.90
26	5.15	4.60	1.90	.25	1.60	1.60	4.00	2.25	2.90
27	5.80	4.35	2.25	.35	1.45	2.05	4.05	3.05	2.90
28	5.00	4.35	1.45	.20	1.55	1.95	4.10	3.25	2.85
29	5.25	5.15	1.45	.30	1.30	1.95	4.05	3.20	2.80
30	4.90	5.45	1.90	.90	1.10	3.50	4.00	2.95	2.80
31	.....	5.60	.....	.60	.95	.....	3.95	.....	2.80

[a] Ice conditions December 10 to 31.

RAQUETTE RIVER NEAR SOUTH COLTON, N. Y.

A temporary gaging station, for use during low water, was established on the Lindsay farm, 2½ miles upstream from South Colton, N. Y., August 17, 1904. The stream stage is observed twice daily by William McDonald from a standard staff gage. Current-meter measurements are made by boat from a rope ferry. The stream bed is of rock, forming a single channel 150 feet in width at ordinary stages, but partially divided by a submerged rock ridge.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Raquette River near South Colton, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 17	Covert and Beebe	627	1.14	0.87	714
August 18	do	626	.96	.80	602
August 24	C. C. Covert	694	1.41	1.24	980
September 22	A. M. Evans	680	1.23	1.10	835
October 19	do	750	2.38	2.16	1,782

Mean daily gage height, in feet, of Raquette River near South Colton, N. Y., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.88	2.62	3.38	1.38	17	.....	1.05	1.85	1.55	2.55
2	.....	.95	2.52	3.20	1.50	18	0.72	1.10	2.35	1.35	2.55
3	.....	1.35	2.50	3.00	1.35	19	.28	.90	2.18	1.50	2.85
4	.....	1.58	2.75	2.92	2.05	20	.18	.48	1.95	1.45	1.65
5	.....	1.32	2.45	2.82	1.70	21	.80	.42	2.02	1.45	2.78
6	.....	.90	2.55	2.70	2.00	22	.95	1.05	2.55	1.30	2.60
7	.....	.85	2.55	2.35	2.25	23	.95	1.50	2.70	1.50	2.50
8	.....	1.25	2.45	2.58	2.10	24	1.22	1.15	2.70	1.35	2.30
9	.....	.98	2.48	2.40	2.15	25	1.10	1.25	2.95	1.40	2.00
10	.....	.92	2.32	2.30	2.30	26	1.12	1.10	2.95	1.38	2.30
11	.....	.98	2.65	2.28	[a]2.50	27	.95	1.20	3.00	1.28	1.80
12	.....	.88	2.60	2.10	2.65	28	.70	1.65	2.98	1.02	1.25
13	.....	.45	2.45	2.30	2.20	29	.55	1.80	2.90	1.50	3.20
14	.....	.85	2.42	1.35	2.90	30	.30	2.55	3.00	1.35	2.85
15	.....	1.38	2.35	1.95	2.80	31	.85	.....	3.02	.....	2.60
16	.....	1.20	2.20	2.22	2.80						

[a] Ice conditions December 11 to 31.

Mean daily discharge, in second-feet, of Raquette River near South Colton, N. Y., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	671	(a)	(a)	1,102	17	.....	823	1,513	1,254	(a)
2	.....	736	(a)	(a)	1,211	18	(b)	866	1,944	1,081	(a)
3	.....	1,081	2,073	(a)	1,081	19	(b)	693	1,793	1,211	(a)
4	.....	1,276	(a)	(a)	1,685	20	(b)	(b)	1,599	1,167	1,340
5	.....	1,060	2,030	(a)	1,388	21	606	(b)	1,664	1,167	(a)
6	.....	693	(a)	(a)	1,642	22	736	823	(a)	1,038	(a)
7	.....	649	(a)	1,944	1,857	23	736	1,211	(a)	1,211	2,073
8	.....	995	2,030	(a)	1,728	24	974	909	(a)	1,081	1,901
9	.....	758	2,051	1,987	1,771	25	866	995	(a)	1,124	1,642
10	.....	714	1,923	1,901	1,901	26	888	866	(a)	1,102	1,091
11	.....	758	(a)	1,879	2,073	27	736	952	(a)	1,016	1,470
12	.....	671	(a)	1,728	(a)	28	(b)	1,340	(a)	802	995
13	.....	(b)	2,030	1,901	1,814	29	(b)	1,470	(a)	1,211	(a)
14	.....	649	2,008	1,081	(a)	30	(b)	(a)	(a)	1,081	(a)
15	.....	1,102	1,944	1,599	(a)	31	649	.....	(a)	.....	(a)
16	.....	952	1,814	1,836	(a)						

[a] Above limit of rating curve. [b] Below limit of rating curve.

LAKE CHAMPLAIN DRAINAGE BASIN.

Lake Champlain occupies a depression between the Adirondack Mountains in New York and the Green Mountains of Vermont. Its surface elevation is normally about 95 feet above tide. The lake forms a boundary between the States of New York and Vermont. Its outlet at Rouses Point is on the boundary line between United States and Canada, and Richelieu River, which receives its outflow, lies entirely in Canada, emptying in the St. Lawrence at Sorel.

Its drainage enters chiefly through large water courses, including Pike River in Quebec, Missoquoi, and Winooski rivers and Otter Creek in Vermont, and the following-named streams in New York:

Tributaries of Lake Champlain in New York.

	Total drainage.
	Sq. miles.
Big Chazy River	299
Little Chazy River	62.9
Saranac River	630
Salmon River	63.8
Little Au Sable River	75.1
Ausable River	521
Bouquet River	269
Lake George outlet	220
Mettawee River	290
Poultney River	266

The inflow through the principal Vermont tributaries is measured at gaging stations in that State. The inflow through Saranac River and Lake George outlet is measured at gaging stations in New York, and temporary stations have also been maintained on Ausable and Bouquet rivers during the low-water season of the present year.

The entire surface of Lake Champlain freezes over nearly every winter. The freezing over of the lake may affect the discharge in two ways:

(1) By holding back as surface storage the depth of water on the frozen lake, equal to about seven-eighths of the ice thickness, thus water being held from the time that freezing takes place in the early winter until the ice melts in the spring.

(2) The freezing modifies the evaporation, the loss from this source probably being less from frozen surface than from open water.

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

A record of the height of Lake Champlain at Rouse Point, the head of Richelieu River, the outlet of the lake, has been kept by the United States Corps of Engineers, beginning 1875.

Through the courtesy of Capt. Harry Taylor, the gage readings taken by William McComb, fort keeper, at 9 a. m. each day are reported weekly to the United States Geological Survey.

The depth of water is taken on a reference mark on the base of the scarp wall, north face of bastian B, about 3 feet from the angle with the east curtain of Fort Montgomery. This reference point is 1.50 feet above an assumed zero, and 1.50 is added to the measured depth to determine the gage reading. In winter the depth as the water rises in a hole in the ice is commonly taken. On windy days the depth is taken in a well within the fort inclosure by measuring the depth on a flagstone in the bottom of the well.

	Above tide.
Elevation of reference point on carp wall of Fort Montgomery [a]	94.998
Elevation of gage zero	93.501
Assumed high water, Lake Champlain	102.611
Assumed low water, Lake Champlain	93.361

The range of rise and fall of the lake is thus seen to be 9.25 feet, representing an available storage volume of 6.24 inches on the entire catchment area. A variation in level of 1 foot per month is equivalent to a continuous storage or draft at the rate of 4,685 second-feet.

The daily discharge from the lake has been determined from observations of the depth and discharge over the Chambly Dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Deep Waterways Survey.

Estimates of the drainage area of Lake Champlain differ considerably. The run-off given in previous reports has been estimated on the basis of a land surface drainage area of 7,750 square miles above the outlet at Rouses Point. The mean monthly discharge, 1875 to 1898, inclusive, has been taken from the computation of the United States Deep Waterways Surveys. The monthly mean corresponds to the mean of the daily gage readings. Beginning with 1899, the mean of the daily discharges taken out for each day of the month is used.

[a] U. S. Deep Waterways Report, Pt. 1, p. 429.

Mean daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.05	1.15	.....	5.10	5.50	4.35	2.75	1.75	1.40	1.50	2.50	1.70
2	1.05	1.10	1.40	5.00	5.60	4.35	2.70	1.60	1.15	1.60	2.60	1.50
3	1.00	1.00	1.70	5.10	5.65	4.25	2.55	1.55	1.25	1.65	2.70	1.60
4	.98	1.05	1.55	5.20	5.60	4.20	2.55	1.50	1.25	1.80	2.60	1.55
5	1.05	1.10	1.45	5.25	5.60	4.10	2.60	1.80	1.30	1.95	2.40	1.70
6	1.05	1.10	1.50	5.20	5.58	4.05	2.55	1.60	1.25	1.65	2.40	1.50
7	1.05	1.12	1.50	5.10	5.65	4.00	2.47	1.45	1.30	1.85	2.35	1.55
8	1.10	1.05	1.65	5.15	5.55	4.00	2.50	1.40	1.20	2.15	2.27	1.45
9	1.00	1.10	1.70	5.25	5.50	3.95	2.53	1.45	1.40	1.80	2.25	1.42
10	1.05	1.10	1.80	5.30	5.35	3.90	2.50	1.70	1.35	2.30	2.20	1.40
11	1.02	1.12	1.85	5.45	5.20	3.85	2.45	1.35	1.55	1.70	2.20	1.38
12	1.00	1.10	1.80	5.60	5.15	3.80	2.40	1.30	1.25	1.80	2.45	1.35
13	1.05	1.12	1.98	5.60	5.05	3.75	2.35	1.40	1.15	1.75	2.05	1.33
14	1.07	1.15	2.05	5.55	5.15	3.80	2.40	1.30	1.50	1.70	1.90	1.30
15	1.00	1.15	2.15	5.60	5.00	3.75	2.35	1.25	1.10	1.70	2.15	1.30
16	1.05	1.10	2.15	5.50	4.90	3.40	2.40	1.30	1.25	1.80	2.00	1.28
17	.98	1.12	2.10	5.45	4.90	3.40	2.10	1.20	1.15	1.85	2.03	1.30
18	1.05	1.15	2.15	5.40	4.80	3.20	2.20	1.15	1.30	1.75	2.10	1.28
19	.98	1.18	2.25	5.40	4.85	3.20	2.15	1.15	1.10	1.78	1.95	1.25
20	1.05	1.20	2.20	5.35	4.83	3.15	2.00	1.50	1.45	2.00	2.00	1.20
21	.95	1.25	2.20	5.30	5.05	3.05	1.90	1.20	1.05	2.10	1.90	1.15
22	1.08	1.35	2.35	5.15	5.10	3.00	1.88	1.55	1.10	2.25	2.05	1.05
23	1.05	1.40	2.30	5.15	5.15	3.10	1.90	1.20	1.30	2.50	1.85	1.08
24	1.05	1.30	2.53	5.30	4.80	3.15	1.85	1.40	1.50	2.47	1.85	1.10
25	1.00	1.35	2.85	5.10	4.85	3.00	1.80	1.55	1.15	2.85	1.83	1.08
26	1.03	1.30	3.25	5.05	4.85	2.85	1.80	1.25	1.40	2.55	1.80	1.10
27	1.07	1.30	3.90	5.10	4.75	2.65	1.85	1.35	1.30	2.50	1.78	1.10
28	1.05	1.35	4.50	5.15	4.70	2.80	1.85	1.40	1.40	2.80	1.75	1.12
29	1.10	1.33	4.70	5.20	4.65	2.85	1.83	1.20	1.70	2.90	2.10	1.15
30	1.10	.....	4.80	5.40	4.60	2.75	1.80	1.25	1.60	2.50	1.75	1.20
31	1.12	.....	4.80	.....	4.45	.....	1.90	1.20	.....	2.55	.....	1.25

Mean daily discharge, in second-feet, of Richelieu River at Fort Montgomery, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6,870	7,210	a7,930	22,180	24,100	18,870	12,700	9,250	8,060	8,400	11,800	9,080
2	6,870	7,040	8,060	21,700	24,620	18,870	12,520	8,740	7,210	8,740	12,160	8,400
3	6,700	6,700	9,080	22,180	24,880	18,450	11,980	8,570	7,550	8,910	12,520	8,740
4	6,620	6,870	8,570	22,660	24,620	18,240	11,980	8,400	7,550	9,420	12,160	8,570
5	6,870	7,040	8,230	22,900	24,620	17,820	12,160	9,420	7,720	9,930	11,460	9,080
6	6,870	7,040	8,400	22,660	24,490	17,610	11,980	8,740	7,550	8,910	11,460	8,400
7	6,870	7,120	8,400	22,180	24,880	17,400	11,720	8,230	7,720	9,590	11,290	8,570
8	7,040	6,870	8,910	22,420	24,360	17,400	11,900	8,060	7,380	10,610	11,040	8,230
9	6,700	7,040	9,080	22,900	24,100	17,310	11,890	8,230	8,060	9,420	10,950	8,140
10	6,870	7,040	9,420	23,140	23,380	17,020	11,800	9,080	7,890	11,120	10,780	8,060
11	6,780	7,120	9,590	23,860	22,660	16,830	11,630	7,890	8,570	9,080	10,780	8,980
12	6,700	7,040	9,420	24,620	22,420	16,640	11,460	7,720	7,550	9,420	11,630	7,890
13	6,870	7,120	10,020	24,620	21,940	16,450	11,290	8,060	7,210	9,250	10,270	7,800
14	6,960	7,210	10,270	24,360	22,420	16,640	11,460	7,720	8,400	9,080	9,760	7,720
15	6,700	7,210	10,610	24,620	21,700	16,450	11,290	7,550	7,040	9,080	10,610	7,720
16	6,870	7,040	10,610	24,100	21,260	15,120	11,460	7,720	7,550	9,420	10,100	7,640

a Interpolated.

Mean daily discharge, in second-feet, of Richelieu River at Fort Montgomery, N. Y., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
17	6,620	7,120	10,440	23,860	21,260	15,120	10,440	7,720	7,210	9,590	10,180	7,720
18	6,870	7,210	10,610	23,620	20,820	14,360	10,780	7,210	7,720	9,250	10,440	7,640
19	6,620	7,300	10,950	23,620	21,040	14,360	10,610	7,210	7,040	9,340	9,980	7,640
20	6,870	7,380	10,780	23,380	20,980	14,170	10,100	8,400	8,230	10,100	10,100	7,380
21	6,530	7,550	10,780	23,140	21,940	13,790	9,760	7,380	6,870	10,440	9,760	7,210
22	6,960	7,890	11,290	22,420	22,180	13,600	9,680	8,570	7,040	10,950	10,270	6,870
23	6,870	8,060	11,120	22,420	22,420	13,980	9,760	7,380	7,720	11,800	9,590	6,960
24	6,870	7,720	11,890	23,140	20,820	14,170	9,590	8,060	8,400	11,720	9,590	7,040
25	6,700	7,890	13,060	22,180	21,040	13,600	9,420	8,570	7,210	13,060	9,500	6,960
26	6,780	7,720	14,550	21,940	21,040	13,060	9,420	7,550	8,060	11,980	9,420	7,040
27	6,960	7,720	17,020	22,180	20,600	12,340	9,590	7,890	7,720	11,800	9,340	7,040
28	6,870	7,890	19,500	22,420	20,380	12,880	9,590	8,060	8,060	12,880	9,250	7,120
29	7,040	7,800	20,380	22,660	20,160	13,060	9,500	7,380	9,080	13,240	10,440	7,210
30	7,040	.....	20,820	23,620	19,940	12,700	9,420	7,550	8,740	11,800	9,250	7,380
31	7,120	.....	20,820	.....	19,290	.....	9,760	7,380	.....	11,980	.....	7,550

Estimated monthly discharge of Richelieu River at Fort Montgomery, N. Y., for 1904.

[Drainage area, 7,750 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	7,120	6,530	6,835	0.882	1.02
February	8,060	6,700	7,309	.943	1.02
March[a]	20,820	8,060	11,630	1.50	1.73
April	24,620	21,700	23,060	2.98	3.32
May	24,880	19,290	22,270	2.87	3.31
June	18,870	12,340	15,610	2.01	2.24
July	12,700	9,420	10,860	1.40	1.61
August	9,420	7,210	8,055	1.04	1.20
September	9,080	6,870	7,737	.998	1.11
October	13,240	8,400	10,330	1.33	1.53
November	12,520	9,250	10,530	1.36	1.52
December	9,080	6,870	7,799	1.01	1.16
The year	24,880	6,530	11,840	1.53	20.77

[a] March 1 interpolated.

SARANAC RIVER NEAR PLATTSBURG, N. Y.

The headwaters of Saranac River lie in the southern part of Franklin County. The southern boundary of the drainage basin is the Ampersand Mountain range. The stream drains the north slope of the most elevated region of the State.

In 1854 a timber dam was built below Lower Saranac Lake for the purpose of flooding logs. In 1899–1901 a masonry dam and lock were erected by the State at this point, raising the water level of Lower Saranac Lake 18 inches.

Drainage areas of Saranac River.[a]

Location.	Area.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Above Saranac Lake State dam	.....	157.5
Above Saranac Lake village	44.9	202.4
Above Franklin Falls	104.3	306.7
North Branch Saranac River	136.6	136.6
At junction North Branch	.....	498.8
Above High Falls	19.6	518.4
Above Cadyville	74.6	593.0
Above Kent Falls	2.9	595.9
Above Morrisonville	2.0	597.9
Above Lozier dam	26.1	624.0
Above mouth	5.6	629.6

[a] From Bien's Atlas of New York State.

About 16.2 per cent of the upper drainage area is water surface.

Saranac River enters Lake Champlain at Plattsburg, and owing to its somewhat equalized flow and rapid fall presents numerous opportunities for power development.

A gaging station was established at this dam March 27, 1903. The record includes the flow over a straight spillway crest 190 feet in length; the discharge through two 5-foot waste gates when open, and the discharge through four 33-inch Victor turbines controlled by automatic governors. Experiments have been made at Cornell University hydraulic laboratory on a model of the ogee section of the dam, from which coefficients have been derived for calculation of the discharge. The gages are read and the record furnished by A. E. Hare.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Mean daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	634	448	374	1,480	2,050	715	415	342	297	(a)	(a)	512
2	498	399	448	1,860	1,940	783	522	341	297	(a)	(a)	496
3	496	416	501	1,930	1,810	650	658	621	624	1,160	(a)	399
4	490	400	400	1,950	1,900	770	572	360	754	945	496	131
5	664	361	381	2,200	1,530	754	600	232	646	803	566	340
6	610	386	305	1,990	1,500	688	561	422	601	753	702	277
7	656	181	519	1,840	1,490	669	398	273	580	756	697	228
8	523	390	719	1,950	1,280	630	384	341	566	(a)	647	227
9	432	515	853	2,390	1,230	692	462	238	418	(a)	697	380
10	485	564	634	3,020	1,050	628	107	324	422	(a)	574	264
11	370	606	581	2,390	1,070	654	(a)	291	405	(a)	439	124
12	428	547	519	1,820	997	493	434	279	400	672	383	242
13	426	498	431	1,560	875	444	420	384	407	778	383	328
14	404	421	700	1,180	934	386	381	386	362	808	549	263
15	428	451	743	1,050	873	403	415	416	420	790	629	262
16	400	554	643	1,160	1,050	384	401	266	407	706	493	308
17	283	477	579	1,110	1,300	401	292	325	521	642	521	240
18	446	460	599	987	1,160	456	360	265	464	643	395	195
19	417	395	568	985	1,080	(a)	282	281	434	475	407	369
20	414	489	349	907	1,240	361	278	462	400	(a)	495	375
21	329	263	646	828	1,340	251	252	706	(a)	(a)	496	252
22	373	428	686	987	1,250	280	220	614	(a)	(a)	455	261
23	526	403	911	1,350	1,150	398	290	800	444	(a)	399	381
24	388	486	1,790	1,450	969	436	224	640	530	(a)	476	343
25	451	451	1,970	1,720	926	520	324	619	572	(a)	486	283
26	414	444	4,460	1,950	922	493	382	475	629	(a)	448	579
27	524	400	4,680	1,720	969	455	400	496	707	(a)	338	467
28	403	219	3,470	1,600	1,010	277	311	348	647	(a)	225	279
29	407	350	2,120	1,630	923	294	402	453	618	(a)	335	383
30	404	.....	1,620	2,030	941	342	366	510	970	615	280	368
31	405	.....	1,570	.....	692	.....	367	338	.....	676	.....	621

a No record. Water being drawn down.

Estimated monthly discharge of Saranac River near Plattsburg, N. Y., for 1904.

[Drainage area, 624 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	664	283	455	0.729	0.840
February	606	181	428	.686	.740
March	4,680	305	1,122	1.80	2.08
April	3,016	828	1,634	2.62	2.92
May	2,053	692	1,208	1.94	2.24
June, 29 days[a]	783	251	507	.812	.876
July, 30 days[a]	658	107	383	.614	.685
August	800	232	414	.663	.764
September, 28 days[a]	970	297	519	.832	.866
October, 15 days[a]	1,160	475	748	1.20	.669
November, 27 days[a]	702	225	482	.772	.775
December	621	124	327	.524	.604

[a] Water being drawn down during the missing days.

AUSABLE RIVER NEAR KEESEVILLE, N. Y.

The drainage basin of Ausable River lies north of Bouquet River, and the stream enters Lake Champlain from the west. This stream drains a rugged mountainous area nearly all timber covered. Two main branches unite at Ausable Forks, about 20 miles from the mouth of the stream along river. In this portion a total descent of 460 feet occurs, a portion of which is in the famous Ausable chasm. The East Branch of Ausable River drains a long, narrow basin, extending northeasterly and southwesterly. There are few lakes or marshes in this area aside from Ausable lakes at the head of the stream. Tributaries numerous and branching.

The North Branch of Ausable River receives the outflow from Lake Placid at elevation 1,864 feet. Numerous smaller lakes feed this branch of the river. Its drainage basin occupies a plateau at a general elevation of 800 to 1,200 feet, the mountainous boundaries of the watershed rising to altitudes of 3,000 to 5,000 feet.

On August 1, 1904, a temporary low-water station was established 3½ miles above Keeseville. It was discontinued September 29.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage areas of Ausable River.[a]

Location.	Area.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Lake Placid water surface	.....	3.8
Lake Placid drainage area	21.8	21.8
West Branch from foot Lake Placid to junction of East Branch	211.2	233.0
East Branch above forks	196.9	429.9
Above gaging station	40.1	470.0
Gaging station to Keeseville	6.1	476.1
Keeseville to Birmingham	27.4	503.5
Birmingham to mouth	17.8	521.3

[a] From Willsboro, Ausable, Lake Placid, Mount Marcy, and Elizabethtown sheets of the United States Geological Survey Topographic Atlas.

Discharge measurements of Ausable River near Keeseville, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 4	Covert and Chase	157	1.53	1.22	239
August 17	E. D. Chase	143	1.35	1.10	193
August 22	do	267	2.88	2.14	770
August 29	do	148	1.34	1.12	198
September 9	do	155	1.40	1.21	217

Mean daily gage height, in feet, of Ausable River near Keeseville, N. Y., for 1904.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	.....	1.1	3.2	12	1.1	1.1	1.7	22	2.3	.....	.....
2	.....	1.1	2.1	13	1.0	1.0	.....	23	2.0	1.1	.....
3	.....	1.2	2.4	14	1.1	1.0	.....	24	1.9	1.3	.....
4	.....	1.3	.....	15	1.0	1.1	2.4	25	1.6	4.0	.....
5	.....	1.3	1.9	16	1.0	1.4	.....	26	1.4	2.7	.....
6	.....	1.4	.....	17	1.0	1.3	.....	27	1.3	2.6	.....
7	1.1	1.3	1.7	18	1.1	1.2	.....	28	1.2	2.0	.....
8	1.1	1.2	1.4	19	1.0	1.1	.....	29	1.2	1.9	.....
9	1.1	.....	1.9	20	1.0	1.1	.....	30	1.2	.....	.....
10	1.0	1.2	1.8	21	3.7	1.2	.....	31	1.1	.....	.....
11	1.0	1.1	1.8								

Mean daily discharge, in second-feet, of Ausable River near Keeseville, N. Y., for 1904.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1	.....	193	12	193	193	22	1,008	.....
2	.....	193	13	170	170	23	636	193
3	.....	218	14	193	170	24	547	246
4	.....	246	15	170	193	25	360	(a)
5	.....	246	16	170	280	26	280	(a)
6	.....	280	17	170	246	27	246	(a)
7	193	246	18	193	218	28	218	636
8	193	218	19	170	193	29	218	547
9	193	.....	20	170	193	30	218	.....
10	170	218	21	(a)	218	31	193	.....
11	170	193						

a Discharge beyond limits of rating curve.

BOUQUET RIVER NEAR WILLSBORO, N. Y.

Bouquet River is tributary to Lake Champlain from the west at a point near Willsboro, N. Y. This stream drains an irregular rectangular area, its eastern edge lying at a distance of 3 to 5 miles from Lake Champlain. The basin is moderately rolling, and has an altitude varying from 300 to 800 feet in the valleys and central portion. The margins of the basin are formed by precipitous mountain ranges rising to altitudes of from 2,000 to 4,000 feet, the greater portion of this rise occurring usually within a few miles of the watershed divide. The interior basin contains a few small lakes and numerous narrow valley marshes. The main stream comprises two branches, the basin of the north branch occupying the northern half of the drainage area. All portions of the catchment area are well drained by branching tributaries.

Drainage areas of Bouquet River. a

Location.	Area.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Above Wadhams Mills	134.6	134.6
Wadhams Mills to Whallonsburg	20.8	155.4
Whallonsburg to junction of North Branch	9.8	165.2
North Branch	100.4	265.6
Junction of branches to Willsboro	3.9	269.5
Willsboro to mouth	2.5	272.0

a From Elizabethtown, Port Henry, Mount Marcy, Ausable, and Willsboro sheets of the United States Geological Survey Topographic Atlas.

During the low-water season of 1904 current-meter measurements were made by boat and cable at a point below the New York and Pennsylvania Company's dam in Willsboro.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Bouquet River near Willsboro, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
July 30	C. C. Covert	113	1.67	1.46	188
August 2	do	96	.92	1.04	88
August 4	Covert and Chase	94	1.00	1.00	94
August 11	E. D. Chase	88	.88	.72	77
August 21	Howell and Chase	206	3.95	2.62	814
August 26	E. D. Chase	88	1.23	.85	108
September 2	do	77	.92	.67	71

Mean daily gage height, in feet, of Bouquet River near Willsboro, N. Y., for 1904.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		0.50	12	−1.20		22	0.65	
2	0.10	−.40	13	−1.50		23	.40	
3	.15	−.40	14			24	.40	
4	.10		15	−.20		25	.20	
5	.10		16	−.40		26	.18	
6	−.25		17	−.10		27	.00	
7	−.50		18	−.60		28	−.10	
8	−.60		19	−.25		29	.00	
9	−1.20		20	−.20		30	.10	
10	−2.00		21	1.15		31	−.80	
11	−.60							

LAKE GEORGE OUTLET AT TICONDEROGA, N. Y.[a]

Lake George occupies a valley extending in a northeasterly and southwesterly direction and lying between Schroon River on the west and the south arm of Lake Champlain on the east. The lake has a general width of from 1 to 2 miles, contains numerous islands, and has precipitous forest-covered slopes reaching to the shore on either side. The inflow is through small tributaries in deep-cut gulleys on the side slopes. The lake lies at elevation 323 feet above tide, and the adjacent hills rise to elevation 1,200 to 2,000 feet within 1 or 2 miles of the lake margin. Outside of the main lake, there is but little water surface within the drainage basin. The total area tributary to the

[a] The drainage basin of Lake George is shown on the Glens Falls, Bolton, Whitehall, Ticonderoga, and adjacent sheets of the United States Geological Survey Topographic Atlas.

lake above its outlet is 220 square miles. Of this 45 square miles are water surface representing 20.5 per cent of the total area.

The outlet of Lake George is a stream 3 miles in length entering Lake Champlain at Fort Ticonderoga. This stream leaves Lake George at a distance of about 1½ miles from Lake Champlain and at an elevation 220 feet greater. It makes an abrupt bend in which occur naturally several cascades over rock. The water power is at present developed by dams located successively along the stream, the uppermost dam controlling the outflow from Lake George.

A gaging station was established at the "B" mill of the International Paper Company at Ticonderoga August 24, 1904. This is the second dam below Lake George. Observations of the depth on the crest of the dam and in the tailrace are taken four times each day by C. E. Carpenter. The dam is of masonry, without leakage, and has a horizontal crest 6 feet in breadth and substantially level. The discharge through the turbines is determined from current meter measurements in the tailrace below the pulp mill.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Lake George outlet at Ticonderoga, N. Y., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 30	C. C. Covert	[a] 7.40	[b] 242
August 30	E. D. Chase	[a] 3.50	[c] 179
September 6	do	[a] 3.65	[c] 178
October 5	A. M. Evans	[d] 4.14	[c] 286

[a] Distance to water surface from mark on bridge support.
[b] Below Lower Falls.
[c] At highway bridge above "A" mill.
[d] Distance to water surface, first projection below bridge seat, downstream corner of left abutment.

Discharge measurements of Lake George outlet at Ticonderoga, N. Y., in 1904.

[Tailrace International Paper Company's "B" mill.]

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
July 30	C. C. Covert	130	1.87	2.41	242
August 5	Covert and Chase	132	1.30	2.15	172
August 24	Horton and Beebe	150	1.45	2.22	217
August 30	E. D. Chase	143	1.48	2.15	212
August 30	do	136	1.14	1.98	155
September 6	do	142	1.39	2.10	198
October 5	A. M. Evans	160	1.57	2.36	252
November 12	H. R. Beebe	136	2.00	2.40	272

METTAWEE RIVER AND TRIBUTARIES IN NEW YORK AND VERMONT.

Mettawee River is an interstate stream rising in Dorset Mountains, Vermont, crossing the State line into New York and Grandville and entering the south arm of Lake Champlain below Whitehall. The drainage basin is a rugged area of rock, mostly forest covered, and tributaries are rather numerous and branching, there being no lakes or marshes. Near Whitehall the stream is joined by Wood Creek.

Wood Creek flowed naturally in a tortuous course in a flat valley skirted by bold slopes, the general course being northerly from a point 5 miles east of Hudson River at Fort Edward. From Smith basin northerly, it is alternately paralleled by and canalized to form Champlain canal, so that the flow of this portion of the stream is artificially controlled.

Half Way Creek, the principal tributary of Wood Creek, enters at Fort Ann. This stream receives the drainage from Putnam Mountain, an adjacent group of small lakes. A declivity of 60 feet occurs at Kane's falls.

Drainage areas of Mettawee River, New York.[a]

Location.	Area.	
	Place to place.	Total.
Wood Creek:	*Sq. miles.*	*Sq. miles.*
Above Fort Ann[b]	63.7	63.7
Fort Ann to mouth	141.2	204.9
Mettawee River:		
Above Middle Granville	161.5	161.5
Middle Granville to junction of Wood Creek	46.1	207.6
Wood Creek	204.9	412.5
Wood Creek to Whitehall	14.1	426.6
Whitehall to mouth	1.2	427.8

[a] From Fort Ann Whitehall, Mettawee, and Glens Falls sheets of the United States Geological Survey Topographic Atlas.
[b] Including Halfway Creek.

The discharge of Mettawee River at the first bridge above the junction of Wood Creek was measured by current meter September 17, 1903, the flow being 57.8 second-feet. Water surface 12.74 feet below coping right-hand abutment downstream corner. The measured discharge is equivalent to .280 second-foot per square mile from the tributary area of 206.5 square miles at this point.

The discharge of Wood Creek at a farm bridge 3 miles above the junction of Mettawee River September 17, 1903, was 84.5 second-feet; water surface 10.58 feet below top of downstream guard rail 5 feet

from left-hand end of bridge. The equivalent discharge in second-feet per square mile was .430. Tributary drainage area, 196.5 square miles.

The precipitation at Glens Falls preceding these measurements was as follows:

	Inch.
August 28 to September 2	0.82
September 2 to 16	0

POULTNEY RIVER AND TRIBUTARIES IN NEW YORK AND VERMONT.

Poultney River rises in a group of lakes in Rutland County, Vt. Above Poultney the drainage is rugged and precipitous. From Poultney to its outlet in the south arm of Lake Champlain the thread of the river forms a boundary line between New York and Vermont.

Castleton River, the principal tributary, enters near Fairhaven. The drainage of this stream lies entirely in Vermont. Castleton River rises in a valley between two parallel ridges of the Green Mountains, flows southward to Rutland, then westward through a low divide of the mountains and receives at Hydeville the outlet of Bomoseen Lake. This lake in turn receives the discharge of a number of smaller tributary lakes. The water-surface elevation of Bomoseen Lake is 413 feet above tide.

Drainage areas of Poultney River.[a]

Location.	Area.	
	Place to place.	Total.
Bomoseen Lake:	*Sq. miles.*	*Sq. miles.*
Bomoseen Lake water surface	.....	3.9
Bomoseen Lake total drainage	.....	38.2
Castleton River:		
Above Hydeville	57.8	96.0
Hydeville to mouth	4.9	100.9
Poultney River:		
Above Castleton River	78.4	179.3
Junction Castleton River to Carver Falls	10.6	189.9
Carver Falls to mouth	75.9	265.8

[a] From Whitehall, Castleton, Mettawee, and Fort Ann sheets of the United States Geological Survey Topographic Atlas.

A current-meter measurement of the flow of Poultney River at Delaware and Hudson River Railroad bridge above junction with Castleton River, September 17, 1903, showed a discharge of 15.1 second-feet. Flow probably influenced by pond storage above.

At Carver Falls, 2 miles below the junction of Poultney and Castleton rivers, occurs a descent of 126 feet over rock. Electric power is developed for transmission to adjoining towns.

GREAT AND LITTLE CHAZY RIVERS AND TRIBUTARIES IN NEW YORK AND VERMONT.

These streams are tributary to the north end of Lake Champlain, from the New York side.

Great Chazy River flows at one point within one-half mile of the United States and Canada boundary line. Its drainage is, however, chiefly from the south and in the United States. The catchment area, which is mostly shown on the Mooers and Rouse Point sheets of the United States Geological Survey Topographic Atlas, is relatively flat and contains numerous swamp areas. At Mooers Forks two main branches of the stream unite. A measurement of the spring freshet discharge April 25, 1899, was made by the United States Deep Waterways Engineers at Champlain, 6 miles above the mouth of the stream; discharge 1,038 second-feet, equivalent to 4 second-feet per square mile from the tributary drainage area of 257 square miles.

Little Chazy River, which enters Lake Champlain 2 miles to the south, has a drainage area of similar character.

FISH CREEK AT BURGOYNE, N. Y.

Fish Creek forms the outlet of Saratoga Lake and is 8 miles in length below the limit of slack water from the lake. It enters Hudson River at Schuylerville, at which point water power is developed. The stream descends 100 feet in the lower 4 miles of its course, the greater portion of this fall being concentrated at Victory Mills.

The drainage basin of Saratoga Lake lies mostly to the north and west of the lake and is chiefly tributary through Kayaderosseras Creek. This stream drains a highland region, having its sources in a range of hills which rise about 800 feet above the general plateau and run in a northwesterly and southeasterly direction. On the main plateau the topography is moderately rolling, tributaries rather sparse, and soil sandy, with few marsh or lake areas.

A temporary gage was attached to the right-hand abutment of Brandt's bridge at Burgoyne station August 25, 1904. Observations of the stage of the stream are taken once each day by G. R. Warner. Current-meter measurements have been made from the bridge. The discharge is not a continuous function of the stage of the stream, however, owing to the growth of grass and aquatic plants in the river channal, thereby causing the velocity to vary with the season. The channel is occasionally cleared of grass by the water-power users in order to facilitate the flow.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Drainage area of Fish Creek.[a]

Location.	Area.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Kayaderosseras Creek above Middle Grove	43.8	43.8
Kayaderosseras Creek, Middle Grove to Ballston Springs	65.8	109.6
Kayaderosseras Creek, Ballston Springs to mouth	85.1	194.7
Saratoga Lake water surface	6.8	.....
Total direct drainage into Saratoga Lake[b]	41.1	235.8

[a] From Saratoga, Schuylerville, Schenectady, Glens Falls, Luzerne, and Broadalbin sheets of the United States Geological Survey Topographic Atlas.
[b] Above Brandt's bridge.

Discharge measurements of Fish Creek at Burgoyne, N. Y., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 25	Horton and Beebe	355	0.80	1.46	[a] 283
October 5	A. M. Evans	339	.92	1.47	311
September 16	R. E. Horton	.....	.....	1.65	301
November 11	H. R. Beebe	.....	.....	1.25	[a] 321

[a] Some grass in channel.

Mean daily gage height, in feet, of Fish Creek at Burgoyne, N. Y., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.06	1.55	1.82	0.80	17	.....	1.46	1.54	1.25	0.30
2	1.10	.....	1.80	.80	18	.....	1.52	1.52	1.22	[a] .30
3	1.08	.....	1.77	.70	19	.....	1.54	1.50	1.20	.30
4	1.20	.....	1.70	.75	20	.....	1.45	1.45	1.20	.20
5	1.17	.....	1.62	.75	21	.....	1.37	1.42	1.15	.20
6	1.05	.....	1.56	.70	22	.....	1.32	1.80	1.15	.20
7	1.05	.....	1.53	.55	23	.....	1.30	2.10	1.10	.20
8	1.05	.....	1.45	.50	24	.....	1.29	2.18	1.10	.20
9	1.00	1.30	1.40	.60	25	.....	1.30	2.20	1.10	.20
10	1.00	1.31	1.36	.55	26	1.45	1.28	2.12	1.10	.50
11	1.00	1.36	1.30	.45	27	1.42	1.28	2.12	1.10	.30
12	.96	1.40	1.25	.40	28	1.40	1.26	2.10	.95	.70
13	.90	1.46	1.20	.35	29	1.26	1.20	2.08	.90	1.00
14	.88	1.50	1.22	.30	30	1.15	1.42	2.00	.85	1.00
15	1.30	1.52	1.26	.35	31	1.12	.....	1.96	.....	1.05
16	1.40	1.55	1.28	.30						

[a] Ice conditions December 18 to 31.

OTTER CREEK AT MIDDLEBURY, VT.

This station was established April 1, 1903, by H. K. Barrows. It is located at the railroad bridge in the village of Middlebury, above and within the influence of the dam used for power purposes. The water, however, never falls below the crest of the dam. The drainage area at this point is 615 square miles. A chain gage is attached to the downstream truss of this bridge; length of chain is 17.52 feet to the 10-foot tag. It is referred to a bench mark on top of south bolt in bridge seat on downstream side of north abutment; elevation 20.08 feet above gage datum. Measurements are made from a boat at medium stages, and from a stone-arch highway bridge about one-quarter mile downstream at low stages of the river. The current at the gage is small, except at high stages of the river; at the stone-arch bridge it is medium at low stages of the river. The banks are high and not subject to overflow, and the bed is permanent. The gage is read twice daily by R. P. Bingham, of Middlebury.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurement of Otter Creek at Middlebury, Vt., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
October 29	H. K. Barrows	118	408	3.18	13.68	[a] 1,300

[a] From arch bridge.

Mean daily gage height, in feet, of Otter Creek River at Middlebury, Vt., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	[a]13.0	16.1	15.3	12.65	12.6	12.25	12.0	14.5	13.1	12.4
2	.....	[a]12.7	.....	15.7	15.4	12.6	12.7	12.3	12.05	14.4	13.0	12.4
3	[b]12.8	.....	.....	15.4	15.4	12.5	13.1	12.4	12.05	13.8	12.85	12.3
4	.....	.....	.....	14.9	15.3	12.45	12.85	12.5	12.4	13.5	12.80	12.2
5	.....	.....	[a]14.6	14.3	15.1	12.45	12.45	12.35	12.1	13.25	12.75	11.9
6	.....	[a]12.6	.....	13.9	14.7	12.4	12.5	12.2	12.2	13.0	12.7	[c]12.1
7	[d]12.6	.....	.....	14.0	14.25	13.2	12.4	12.2	12.25	12.9	12.65	.....
8	.....	.....	[a]15.6	14.4	13.7	12.85	12.3	11.9	12.2	12.8	12.6	[c]12.2
9	[d]12.5	.....	.....	14.7	13.3	13.3	12.2	12.0	12.15	12.8	12.5	.....
10	.....	[a]14.7	.....	15.0	13.2	13.05	12.15	12.1	12.1	12.7	12.4	.....
11	.....	.....	.....	15.0	13.3	12.85	11.9	12.05	12.1	12.9	12.4	.....
12	[d]12.5	.....	[f]14.7	15.1	13.4	12.65	11.95	12.15	11.9	13.4	12.4	.....
13	.....	[f]13.7	.....	15.1	13.25	12.4	12.35	12.25	11.9	13.4	12.4	[g]12.1
14	.....	.....	.....	15.0	13.1	12.4	12.35	12.25	12.0	13.3	12.4	.....
15	.....	.....	[a]13.4	14.7	13.0	12.3	12.3	12.05	12.5	13.2	12.4	.....
16	[h]12.5	[f]13.0	.....	14.15	13.1	12.3	12.2	12.1	13.55	13.05	12.4	.....

[a] Ice 1.35 feet thick.
[b] Ice 0.65 foot thick.
[c] River frozen over.
[d] Ice 1 foot thick.
[e] Ice 0.15 foot thick.
[f] Ice 1.4 feet thick.
[g] Ice 0.6 foot thick.
[h] Ice 0.85 foot thick.

Mean daily gage height, in feet, of Otter Creek River at Middlebury, Vt., etc.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
17	.....	.....	.....	13.75	14.1	12.3	12.1	12.2	13.5	12.9	12.4	.....
18	.....	.....	.....	13.7	14.25	12.2	11.9	12.15	13.15	12.8	12.2	.....
19	[a]12.5	.....	[b]12.9	13.8	14.0	12.1	12.1	12.05	12.95	12.7	12.3	.....
20	.....	[c]12.8	.....	13.85	14.3	11.85	12.1	12.05	12.8	12.7	12.35	[d]12.05
21	.....	.....	.....	13.7	14.5	12.1	12.0	12.5	13.0	12.85	12.4	.....
22	[b]12.4	.....	.....	13.7	14.5	12.2	12.0	12.8	12.85	14.8	12.95	[e]12.15
23	.....	[f]14.5	[g]13.4	13.7	14.2	12.2	11.9	12.9	12.7	14.8	12.95	.....
24	.....	.....	.....	13.8	13.7	12.15	12.0	12.8	12.5	14.65	12.9	.....
25	[b]13.0	.....	.....	14.05	13.35	12.1	11.8	12.65	13.0	14.25	12.7	.....
26	.....	.....	[g]15.3	14.4	13.3	12.1	11.85	12.45	13.35	13.8	12.7	.....
27	.....	[f]13.6	.....	14.4	13.35	11.95	12.1	12.3	13.6	13.85	12.55	.....
28	.....	.....	.....	14.65	13.15	12.1	12.4	12.3	13.45	14.1	12.25	.....
29	.....	.....	15.35	15.05	12.9	12.1	12.3	11.9	13.3	13.8	12.15	.....
30	[f]12.7	.....	16,0	15.3	12.7	12.1	12.4	12.0	14.4	13.5	12.3	[h]13.5
31	.....	.....	16.3	.....	12.65	.....	12.5	12.1	.....	13.2	.....	.....

[a] Ice 0.9 foot thick.
[b] Ice 1.25 feet thick.
[c] Ice 1.4 feet thick.
[d] Ice 0.85 foot thick.
[e] Ice 0.85 foot thick. Gage reading to surface of ice=12.2.
[f] Ice 1.35 feet thick.
[g] Ice covered with water.
[h] Water 1.25 feet deep on top of ice.

NOTE.—During frozen season gage heights are to surface of water in hole cut in ice.

Rating table for Otter Creek at Middlebury, Vt., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
11.60	163	12.80	670	14.00	1,645	15.20	2,930
11.70	188	12.90	740	14.10	1,745	15.30	3,040
11.80	217	13.00	810	14.20	1,845	15.40	3,150
11.90	248	13.10	880	14.30	1,950	15.50	3,265
12.00	283	13.20	955	14.40	2,055	15.60	3,380
12.10	320	13.30	1,030	14.50	2,160	15.70	3,495
12.20	360	13.40	1,110	14.60	2,270	15.80	3,610
12.30	403	13.50	1,190	14.70	2,380	15.90	3,725
12.40	450	13.60	1,275	14.80	2,490	16.00	3,840
12.50	501	13.70	1,365	14.90	2,600	16.10	3,955
12.60	555	13.80	1,455	15.00	2,710	16.20	4,070
12.70	610	13.90	1,550	15.10	2,820	16.30	4,185

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined to gage height 14 feet. Above 14 feet it is determined by one measurement.

Estimated monthly discharge of Otter Creek at Middlebury, Vt., for 1904.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	3,955	1,365	2,198	3.57	3.98
May	3,150	582	1,623	2.64	3.04
June	1,030	232	471	.766	.855
July	880	217	396	.644	.742
August	740	248	398	.647	.746
September	2,055	248	661	1.07	1.19
October	2,490	610	1,225	1.99	2.29
November	880	340	545	.886	.988
December 1–6	450	248	372	.605	.135

NOTE.—Ice conditions January 1 to March 31 and December 7–31. No estimate made.

WINOOSKI RIVER AT RICHMOND, VT.

This station was established June 25, 1903, by H. K. Barrows. It is located at the steel highway bridge about one-fourth mile from Richmond railway station on the road to Huntington. The drainage area at this point is 885 square miles. A standard chain gage is attached to the downstream truss; length of chain, 29.61 feet. It is referred to bench marks as follows: (1) On top of plate near north end of gage box; elevation, 28.76 feet. (2) Marked point on the west end of south abutment; elevation, 27.42 feet. Elevations are above gage datum. The channel is straight for 100 feet above and 100 feet below this station, and is about 175 feet wide. The bed is gravelly and permanent. The current is medium except at low water. Gagings at low stages of the river are made by wading at a point 2,500 feet upstream from bridge, where the bed is of gravel and the current swift. The banks are fairly high, but overflow at extreme high water. The gage is read twice daily by George Champang, a farmer, of Richmond.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Winooski River at Richmond, Vt., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 4	H. K. Barrows	182	1,590	2.27	7.10	3,610
May 7	J. H. Ayres	182	1,380	1.71	6.16	2,360
May 10	do	182	1,370	1.41	5.89	1,930
August 18	H. K. Barrows	161	171	2.06	4.08	[a]352
October 31	do	180	1,230	.98	5.08	1,210

[a] Wading one-half mile upstream.

Mean daily gage height, in feet, of Winooski River at Richmond, Vt., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a]5.8	[b]5.7	[c]6.1	7.0	8.65	4.75	4.15	4.1	3.9	7.6	4.8	4.5
2	.....	.....	.....	6.8	7.9	4.75	4.3	4.2	3.95	7.95	4.8	4.55
3	.....	.....	.....	6.9	7.4	4.7	4.8	4.2	4.0	6.6	4.7	4.65
4	.....	.....	[d]5.9	6.45	7.3	4.6	4.4	4.1	5.1	5.95	4.7	[e]4.95
5	[f]5.65	[g]5.75	.....	6.55	7.0	4.5	4.25	4.2	4.8	5.5	4.7	.....
6	.....	.....	.....	7.2	6.5	4.55	4.3	4.05	4.5	5.4	4.6	.....
7	.....	.....	[h]6.7	7.85	6.2	4.6	4.2	4.0	4.35	5.3	4.6	.....
8	[i]5.75	.....	.....	7.8	6.1	4.8	4.05	3.9	4.25	5.0	4.5	.....
9	.....	[j]5.95	.....	9.15	5.9	5.3	4.1	4.0	4.1	5.0	4.5	[k]5.2
10	.....	.....	.....	9.2	5.85	4.9	4.0	4.0	4.05	4.9	4.35	.....
11	.....	.....	[l]6.4	8.4	5.75	4.6	4.0	4.0	4.0	5.2	4.3	.....
12	[i]5.8	[m]6.2	.....	7.6	5.7	4.4	4.0	4.05	3.85	5.25	4.3	.....
13	.....	.....	.....	7.35	5.4	4.4	4.9	4.0	3.9	5.05	4.4	.....
14	.....	.....	.....	6.65	5.3	4.3	4.8	4.0	4.0	5.15	4.4	.....
15	[n]5.75	.....	[l]6.5	6.3	5.1	4.25	4.45	4.3	4.3	5.2	4.5	.....
16	.....	[m]6.1	.....	6.05	6.3	4.4	4.15	4.2	5.15	5.1	4.4	[o]4.95
17	.....	.....	.....	5.8	7.5	4.2	4.05	4.15	4.6	4.9	4.5	.....
18	.....	.....	[p]6.6	6.2	6.2	4.0	4.0	3.95	4.25	4.8	4.35	.....
19	[n]5.7	[m]6.05	.....	6.3	6.0	4.0	4.0	3.9	4.5	4.7	4.7	.....
20	.....	.....	.....	6.1	7.85	4.05	3.9	4.0	4.8	4.7	4.6	.....
21	.....	.....	.....	6.2	7.1	4.1	3.9	6.6	6.6	5.85	4.65	.....
22	[q]5.85	.....	.....	6.25	6.2	4.2	3.9	5.25	5.4	10.0	5.1	.....
23	.....	[c]6.0	.....	6.8	5.9	4.25	3.9	5.25	4.9	6.6	4.7	[r]5.0
24	.....	.....	11.15	7.1	5.7	4.2	3.9	4.7	5.05	5.95	4.6	.....
25	.....	.....	12.7	8.4	5.55	4.1	3.75	4.4	6.7	5.6	4.6	.....
26	[s]5.8	[c]6.0	17.95	8.6	5.6	4.0	3.95	4.2	5.75	5.4	4.6	.....
27	.....	.....	15.3	7.5	5.6	4.15	4.35	4.1	5.7	5.8	4.4	.....
28	.....	.....	13.4	7.65	5.35	4.05	4.6	4.0	5.3	5.7	4.4	.....
29	[b]5.75	.....	9.7	8.9	5.0	4.1	4.5	3.85	5.0	5.6	4.5	.....
30	.....	.....	6.7	9.95	4.9	4.15	4.35	3.9	8.55	5.35	4.6	[t]5.0
31	.....	.....	6.8	.....	4.8	.....	4.2	3.9	.....	5.1	.....	.....

[a] Gage reading to ice surface=5.85; ice 1.35 feet thick.
[b] Gage reading to ice surface=5.85; ice 2.1 feet thick.
[c] Gage reading to ice surface=6.5; ice 2.75 feet thick.
[d] Gage reading to ice surface=6.4; ice 2.65 feet thick.
[e] River frozen over December 4.
[f] Gage reading to ice surface=5.7; ice 1.45 feet thick.
[g] Gage reading to ice surface=5.85; ice 2.15 feet thick.
[h] Gage reading to ice surface=7.0; ice 2.65 feet thick.
[i] Gage reading to ice surface=5.8; ice 1.6 feet thick.
[j] Gage reading to ice surface=6.2; ice 2.4 feet thick.
[k] Gage reading to ice surface=5.3; ice 0.6 foot thick.
[l] Gage reading to ice surface=6.9; ice 2.65 feet thick.
[m] Gage reading to ice surface=6.6; ice 2.75 feet thick.
[n] Gage reading to ice surface=5.8; ice 1.65 feet thick.
[o] Gage reading to ice surface=5.05; ice 1.1 feet thick.
[p] Gage reading to ice surface=6.75; ice 2.6 feet thick.
[q] Gage reading to ice surface=5.85; ice 1.6 feet thick.
[r] Gage reading to ice surface=5.05; ice 1.4 feet thick.
[s] Gage reading to ice surface=5.85; ice 1.85 feet thick.
[t] Gage reading to ice surface=5.4; ice 1.65 feet thick.

NOTE.—During frozen season gage readings to surface of water in hole cut in ice.

Rating table for Winooski River at Richmond, Vt., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	140	4.90	900	6.00	2,090	7.10	3,610
3.80	165	5.00	1,000	6.10	2,220	7.20	3,750
3.90	195	5.10	1,100	6.20	2,350	7.30	3,890
4.00	235	5.20	1,200	6.30	2,490	7.40	4,030
4.10	285	5.30	1,300	6.40	2,630	7.60	4,310
4.20	340	5.40	1,410	6.50	2,770	7.80	4,590
4.30	400	5.50	1,520	6.60	2,910	8.00	4,870
4.40	470	5.60	1,630	6.70	3,050	8.20	5,150
4.50	540	5.70	1,740	6.80	3,190	8.40	5,430
4.60	620	5.80	1,850	6.90	3,330	8.60	5,710
4.70	710	5.90	1,970	7.00	3,470	8.80	5,990
4.80	800						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined between gage heights 3.7 feet and 7.5 feet. The table has been extended above gage height 7.50 feet. Above gage height 6.20 feet the rating curve is a tangent, the difference being 140 per tenth.

Estimated monthly discharge of Winooski River at Richmond, Vt., for 1904.

[Drainage area, 885 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	7,600	1,850	3,893	4.40	4.91
May	5,780	800	2,412	2.73	3.15
June	1,300	235	482	.545	.608
July	900	152	365	.412	.475
August	2,910	180	433	.489	.564
September	5,640	180	998	1.13	1.26
October	7,670	710	1,822	2.06	2.38
November	1,100	400	599	.677	.755

NOTE.—River frozen during January, February, March, and December. No estimate made.

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 129.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. Every member of Congress is allotted a certain number, from whom they may be obtained, free of charge, on application.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco, Cal., 422 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 424 Peyton Block; Pendleton, Oreg.

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WASHINGTON, D. C.

AUGUST, 1905.

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. . . Report of progress of stream measurements for the calendar year 1904. Prepared under the direction of F. H. Newell by R. E. Horton, E. Johnson, jr., and John C. Hoyt. pt. VI.—Great Lakes and St. Lawrence River drainage. Washington, Gov't print. off., 1905.

150, iii p. illus., II pl. (incl. map) 23cm. (*Its* Water-supply and irrigation paper no. 129)

Subject series: P, Hydrographic progress reports, 34.

1. Stream measurements. 2. Rivers—U. S. I. Horton, Robert Elmer, 1875– II. Johnson, Edward, jr., 1876– III. Hoyt, John Clayton, 1874–

Subject.

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Water-supply and irrigation papers.

no. 129. Report of progress of stream measurements for . . . 1904 . . . by R. E. Horton, E. Johnson, jr., and J. C. Hoyt. pt. VI. 1905.

Reference.

U. S. Dept. of the Interior.

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Water-Supply and Irrigation Paper No. 130 Series P, Hydrographic Progress Reports, 35

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

BY

CYRUS C. BABB and JOHN C. HOYT

PART VII.—Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River Drainages

WASHINGTON

GOVERNMENT PRINTING OFFICE

1905

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., April 20, 1905.

SIR: I transmit herewith the manuscript of Part VII of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of C. C. Babb, district engineer, who was assisted by A. E. Place, L. R. Stockman, Robert Follansbee, and W. B. Freeman. A portion of the data given herein was collected under the direction of M. C. Hinderlider and E. Johnson, jr., as noted in the acknowledgments. The assembling of the data and their preparation for publication were done under the direction of J. C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, W. E. Hall, and F. H. Tillinghast.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART VII.

By CYRUS C. BABB and JOHN C. HOYT.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	20,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

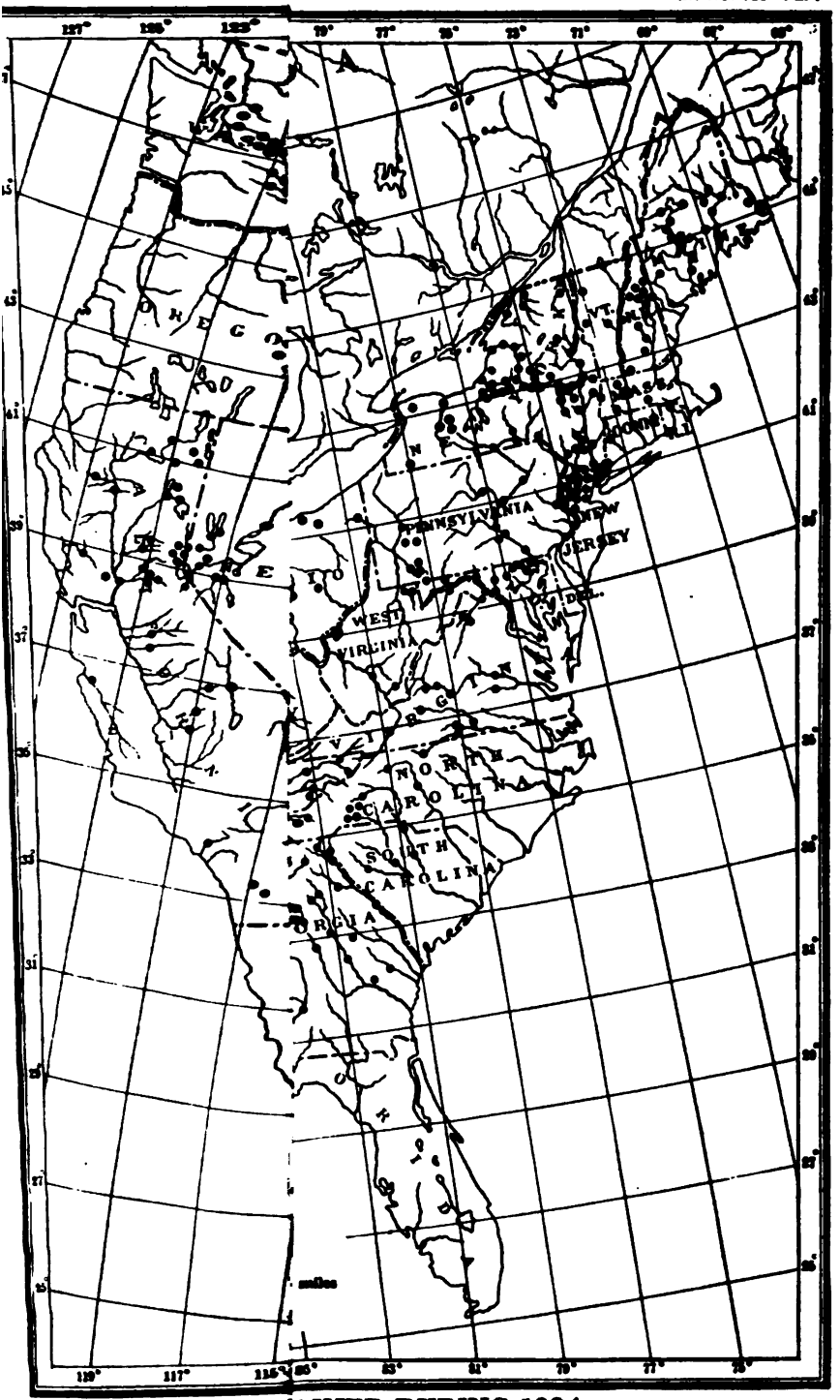
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage readings. From these two factors it is possible to estimate both the total flow and its distribution through the period of observations.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations; and second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station with car, tag-line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tagged line indicating the points of measurement. Where the current is swift some appli-



MAINED DURING 1904.

ance—generally a secondary cable—is necessary to hold the meter in position below the surface.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. Great care is taken in the selection and equipment of gaging stations, in order that the data may have the required degree of accuracy.

On many of the larger rivers where water power is developed by dams estimates of flow are obtained by observing the head on the crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

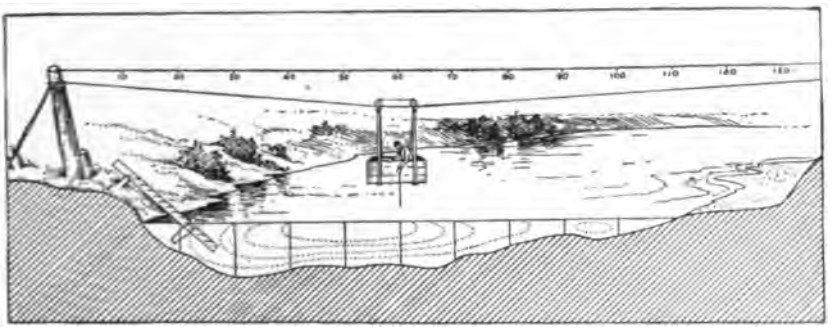


FIG. 1.—Cable station, showing section of river, car, gage, etc.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points

are usually at regular intervals varying from 2 to 20 feet, depending upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and soundings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth, for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between .94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from .85 to .95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity-curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity-curve and the initial line. Owing to the length of time it takes to make these measurements, they

PRICE CURRENT METERS, WITH BUZZERS.

are seldom used except for determining coefficients for purposes of comparison, and for measurements under ice.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity, twice the mid-depth velocity, and the bottom velocity, by 4.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights. (2 and 3 depend on 1.)

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds, the results of the discharge measurements are plotted on cross-section paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared.

The mean velocity and area determined for each discharge measurement are also plotted. Through these points the curves of mean velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value in determining the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station rating curve, the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character, the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made, the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes occur.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are taken either by integration in verticals or by the vertical velocity-curve method, as sufficient experiments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part VII, is published in a series of twelve

Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainages.
Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.
Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainages.
Part 5. Eastern Mississippi River drainage.
Part 6. Great Lakes and St. Lawrence River drainage.
Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.
Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.
Part 9. Western Gulf of Mexico drainage.
Part 10. Colorado River and the Great Basin drainage.
Part 11. The Great Basin and Pacific Ocean drainages in California.
Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations and such other information that has been collected that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the two remaining columns which are defined on page 14 are based.

In the computations for the tables of this report the following rules have been used in general:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity

shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications. A detailed index of these reports (from 1888–1903) is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Iowa.—District hydrographer, E. Johnson, jr.,[a] assisted by F. W. Hanna, assistant engineer. Acknowledgment should be made to Frank Dearborn, Stone City, Iowa, who assisted in establishing a gage at Stone City, and supplied voluntary readings for the same.

Kansas.—Resident hydrographer, W. G. Russell.[b] Acknowledgments are due the Atchison, Topeka and Santa Fe; Union Pacific; Missouri, Kansas and Texas; and Chicago, Rock Island and Pacific railway companies for annual passes issued to Mr. Russell.

Minnesota.—District hydrographer, E. Johnson, jr.,[a] assisted by F. W. Hanna, assistant engineer.

Missouri.—District hydrographer, E. Johnson, jr.,[a] assisted by F. W. Hanna, assistant engineer. Acknowledgments should be made to the St. Louis and San Francisco Railroad for transportation furnished to Mr. Hanna between St. Louis and Arlington, Mo., and to George B. Mainprize for voluntary observations at Greer Springs, Greer, Mo.

Montana.—District engineer, C. C. Babb,[c] assisted by A. E. Place, L. R. Stockman, and Robert Follansbee, assistant engineers, and W. B. Freeman, engineering aid.

Nebraska.—Resident hydrographer, J. C. Stevens.[b] Valuable assistance was rendered by Prof. O. V. P. Stout, of the University of Nebraska, in the way of the free use by the resident hydrographer of office facilities and suggestions in the methods for the collection of field data. Acknowledgments are also due the Chicago, Burlington and Quincy; Chicago and Northwestern; and Fremont, Elkhorn and Missouri Valley railroads for annual passes issued in favor of Mr. Stevens.

North Dakota.—District hydrographer, E. Johnson, jr.,[a] assisted by E. F. Chandler, of the engineering department of the University of North Dakota.

South Dakota.—Resident hydrographer, R. F. Walter,[b] assisted by F. M. Madden, engineering aid.

Wyoming.—The hydrographic work in this State has been carried on under the direction of the district hydrographer, M. C. Hinderlider,[b] and by the resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming to the Union Pacific; Chicago, Burlington and Quincy; Colorado and Southern; Colorado and Wyoming; and Fremont, Elkhorn and Missouri Valley railroads.

HUDSON BAY DRAINAGE BASIN.

Red River drains a large basin in the United States, covering portions of Minnesota and North and South Dakota, characterized by a level topography, broken up in places by moraines and other glacial deposits. The major part is prairie, and its eastern half has an abundance of lakes and some woods. The main river flows nearly due north, cutting a deep channel in its broad, level valley, and is subject

[a] The office of the district hydrographer for Iowa, Minnesota, Missouri, and North Dakota is 876 Federal Building, Chicago, Ill.

[b] The office of the district hydrographer for Kansas, Nebraska, South Dakota, and Wyoming is Chamber of Commerce Building, Denver, Colo.

[c] The office of the district engineer, in charge of hydrographic work in Montana, is Browning, Teton County, Mont.

to sudden rises caused by heavy spring rains, entailing frequently considerable loss of life and property. The valley of Red River comprises about 9,000,000 acres of excellent agricultural lands, which to a large extent still await settlement. A number of water powers have been developed during recent years on the tributaries entering from both sides.

Red River drains into Hudson Bay through Lake Winnipeg and Nelson River. Red Lake River, one of its principal tributaries in Minnesota, drains Red Lake in the northern part of the State. Sheyenne River, its principal tributary from North Dakota, joins Red River about 10 miles below Fargo, N. Dak.

St. Mary River heads in northern Montana, near the Canadian boundary line, on the eastern slope of the main range of the Rocky Mountains, in a region of perpetual snow and in the midst of numerous glaciers. It starts from the great Blackfoot Glacier (probably the largest in the Rocky Mountains within the United States) and receives affluents from at least a dozen lesser ones. These small streams unite within a short distance from their sources and flow into a lake hemmed in by high mountains, known as Upper St. Mary Lake. Below this, separated by a narrow strip of land, is Lower St. Mary Lake. The aggregate length of these two lakes is about 22 miles. The river flows out of the lower lake, the elevation of which is 4,460 feet above sea level, and within 2 miles is joined by a stream nearly if not quite as large as itself, known as Swift Current Creek, which receives the water of the Grinnell Glacier and four lesser ones. From the confluence of these streams to the boundary of the British possessions, a distance of 12 miles, the river flows in a northerly direction. Kennedy Creek is a small tributary entering St. Mary River a few miles before the latter crosses the Canadian boundary. Entering Alberta it empties into Belly River, its waters at length finding their way through Saskatchewan River into Hudson Bay. A canal has been constructed in Canada by the Canadian Northwest Irrigation Company which diverts water from the right bank of St. Mary River about 5 miles below the international boundary line.

ST. MARY RIVER NEAR ST. MARY, MONT.

This station was established April 9, 1902, by J. S. Baker. It is located on Henry Henkel's ranch, about 1 mile east of his house, and is 35 miles northwest of Browning, Mont. It is also about 4,500 feet below Lower St. Mary Lake. The gage, which is located about 1,000 feet above the cable from which the measurements are made, is of the wire type. It is supported upon a horizontal arm which extends over the river and is fastened to a cottonwood stump. The scale board is graduated to feet and tenths. The length of the wire from the bottom of the weight to the marker is 11.40 feet. A new wire gage was

installed by C. T. Prall, June 17, 1903. It reads the same and has the same length of wire as the 1902 gage. The gage is read once each day by Henry Henkel, who lives about 1 mile west of the station. Discharge measurements are made by means of a cable, car, and tagged wire. The cable is fastened to a cottonwood tree on each bank. The initial point for soundings is on the left bank at the middle of the cot tonwood tree to which the cable is fastened. The channel is straight for 500 feet above and for 200 feet below the station. Both banks are high and rocky and have gentle slopes. The current has a moderate velocity. The bed of the stream is composed of gravel and bowlders. Bench mark No. 1 is a spike in the foot of a cottonwood tree 30 feet north of the gage. It is marked B. M. 9.24, denoting its elevation above gage datum. Bench mark No. 2 was a wire spike in the rear post of the gage, and was marked B. M. 6.97. Its elevation above gage datum was 6.97 feet. This bench mark has been destroyed. Bench mark No. 3 is a 60-penny spike in the base of a cottonwood tree 125 feet above the gage. Its elevation is 9.61 feet above gage datum.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of St. Mary River near St. Mary, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 9	L. R. Stockman	91	202	4.34	3.13	878
June 8	W. B. Freeman	101	360	5.91	4.73	2,130
July 11	Robert Follansbee	100	309	5.73	4.30	1,771
July 29	W. B. Freeman	96	202	4.21	3.20	851
August 31	do	87	135	3.27	2.42	441
November 18	L. R. Stockman	49	46	1.34	1.25	62

Mean daily gage height, in feet, of St. Mary River near St. Mary, Mont., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					3.00	4.30	4.30	3.00	2.40	1.90	1.50	1.30
2					3.10	4.30	4.30	3.00	2.40	1.90	1.50	1.20
3				1.00	3.20	4.40	4.30	3.00	2.30	1.90	1.50	1.20
4				1.00	3.20	4.40	4.40	3.00	2.70	1.90	1.50	1.20
5				1.00	3.20	4.40	4.40	3.00	2.30	1.90	1.40	1.20
6				1.00	3.20	4.50	4.40	3.00	2.30	1.90	1.40	1.20
7				1.00	3.10	4.50	4.40	3.00	2.30	1.90	1.40	1.20
8				1.10	3.10	4.60	4.40	3.00	2.30	1.90	1.40	1.20
9				1.10	3.10	4.70	4.40	3.00	2.30	1.90	1.40	1.20

[a] River frozen from January 1 to 10 and from January 20 to April 3, when ice went out.

Mean daily gage height, in feet, of St. Mary River near St. Mary, Mont., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
10	.....	.....	.....	1.10	3.10	4.70	4.40	3.00	2.30	1.80	1.30	1.20
11	1.80	.....	.....	1.10	3.10	4.70	4.40	3.00	2.30	1.80	1.30	1.20
12	1.80	.....	.....	1.20	3.00	4.60	4.30	3.00	2.20	1.80	1.30	1.20
13	1.80	.....	.....	1.20	3.00	4.40	4.30	3.00	2.20	1.80	1.30	1.20
14	1.70	.....	.....	1.30	3.00	4.20	4.30	3.00	2.20	1.80	1.30	1.20
15	1.70	.....	.....	1.30	3.10	4.30	4.30	2.90	2.20	1.80	1.30	1.20
16	1.60	.....	.....	1.40	3.10	4.40	4.10	2.90	2.10	1.80	1.30	1.20
17	1.50	.....	.....	1.40	3.10	4.40	3.90	2.80	2.10	1.80	1.30	1.20
18	1,50	.....	.....	1.40	3.20	4.60	3.70	2.80	2.10	1.80	1.30	1.20
19	1.50	.....	.....	1.40	3.30	4.60	3.60	2.70	2.10	1.80	1.30	1.20
20	.....	.....	.....	1.80	3.40	4.80	3.50	2,80	2.10	1.70	1.40	1.20
21	.....	.....	.....	2.10	3.60	4.90	3.30	2.80	2.10	1.70	1.50	1.20
22	.....	.....	.....	2.40	4.00	4.80	3.20	2.80	2.10	1.70	1.50	(a)
23	.....	.....	.....	2.50	4.20	4.80	3.20	2.70	2.00	1.70	1.50	.....
24	.....	.....	.....	2.50	4.40	4.70	3.10	2.70	1.90	1.60	1.40	.....
25	.....	.....	.....	2.50	4.60	4.70	3.10	2.60	1.90	1.50	1.30	.....
26	.....	.....	.....	2.50	4.60	4.50	3.10	2.50	1.90	1.50	1.30	.....
27	.....	.....	.....	2.60	4.40	4.20	3.10	2.40	1.90	1.50	1.30	.....
28	.....	.....	.....	2.60	4.30	4.20	3.10	2.40	1.90	1.50	1.30	.....
29	.....	.....	.....	2.70	4.20	4.20	3.20	2.30	1.90	1.50	1.30	.....
30	.....	.....	.....	2.90	4.20	4.20	3.10	2.30	1.90	1.50	1.30	.....
31	.....	.....	.....	.....	4.30	.....	3.00	2.40	.....	1.50	.....	.....

a River frozen.

Rating table for St. Mary River near St. Mary, Mont., from April 9, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	20	2.10	335	3.20	950	4.60	2,110
1.10	33	2.20	375	3.30	1,020	4.80	2,295
1.20	50	2.30	420	3.40	1,090	5.00	2,490
1.30	72	2.40	465	3.50	1,160	5.20	2,700
1.40	98	2.50	515	3.60	1,235	5.40	2,920
1.50	127	2.60	565	3.70	1,315	5.60	3,160
1.60	158	2.70	620	3.80	1,395	5.80	3,400
1.70	190	2.80	675	3.90	1,480	6.00	3,640
1.80	223	2.90	740	4.00	1,570	6.20	3,880
1.90	258	3.00	810	4.20	1,750	6.40	4,120
2.00	295	3.10	880	4.40	1,930	6.60	4,360

The above table is applicable only for open-channel conditions. It is based upon 38 discharge measurements made during 1902, 1903, and 1904. It is well defined between gage heights 1.25 and 6 feet. The table has been extended beyond these limits.

The table supersedes those published in 1902 and 1903. Above 3 feet it has not been changed.

Estimated monthly discharge of St. Mary River near St. Mary, Mont., 1902–1904.

[Drainage area, 177 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1902.						
January [a]	.....	.....	110	6,764	0.62	0.71
February [a]	.....	.....	120	6,664	.68	.71
March [a]	.....	.....	100	6,149	.56	.65
April [b]	223	120	146	8,688	.82	.91
May	4,000	190	1,729	106,312	9.77	11.26
June	3,760	950	1,862	110,796	10.52	11.74
July	4,360	1,160	2,164	133,059	12.23	14.10
August	1,160	565	785	48,267	4.44	5.12
September	515	258	342	20,350	1.93	2.15
October	258	190	221	13,589	1.25	1.44
November	190	127	156	9,282	.88	.98
December [c]	.....	.....	130	7,993	.73	.84
The year	.....	.....	655	477,913	3.70	50.61
1903.						
January [d]	158	72	93	5,718	.53	.61
February [d]	72	72	72	3,999	.41	.43
March [d]	72	50	57	3,505	.32	.37
April	223	72	129	7,676	.73	.81
May	2,110	223	743	45,685	4.20	4.84
June	3,640	2,110	3,154	187,676	17.82	19.89
July	3,280	1,160	1,832	112,645	10.35	11.93
August	1,160	675	860	52,879	4.86	5.60
September	1,160	465	643	38,261	3.63	4.05
October	1,090	465	646	39,721	3.65	4.20
November	465	295	379	22,552	2.14	2.39
December [e]	335	295	305	18,753	1.72	1.98
The year	3,640	50	743	539,070	4.20	57.10
1904.						
January [f]	.....	.....	120	7,379	.68	.78
February [f]	.....	.....	80	4,602	.45	.49

[a] Estimated by C. C. Babb.
[b] April 1–8, estimated by C. C. Babb.
[c] Frozen December 7 to 25, 1902. Mean estimated by C C. Babb.
[d] Probable ice conditions during January, February, and March. Rating table has been applied as for open channel.
[e] December 11 to 31, 1903, estimated by C. C. Babb.
[f] Frozen January 1 to 10, January 20 to April 2, and December 22 to 31. Means for January, February, March, and December estimated by C. C. Babb

Estimated monthly discharge of St. Mary River near St. Mary, Mont., 1902–1904—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
March [a]	----------	----------	80	4,919	.45	.52
April [a]	740	20	216	12,853	1.22	1.36
May	2,110	810	1,220	75,015	6.89	7.94
June	2,390	1,750	2,021	120,258	11.42	12.74
July	1,930	810	1,456	89,526	8.23	9.49
August	810	420	689	42,365	3.89	4.48
September	620	258	362	21,541	2.05	2.29
October	258	127	205	12,605	1.16	1.34
November	127	70	91	5,415	.51	.57
December [a]	72	50	51	3,136	.29	.33
The year	----------	----------	549	399,614	3.10	42.23

[a] Frozen January 1 to 10, January 20 to April 2, and December 22 to 31. Means for January, February, March, and December estimated by C. C. Babb.

ST. MARY RIVER NEAR CARDSTON, ALBERTA, N. W. T.

This station was established September 4, 1902, by C. T. Prall, at the ranch of L. C. Shaw, about 1,000 feet from the house. It is one-fourth of a mile north of the boundary line between the United States and Canada, and 17 miles south of Cardston, Alberta. The chain gage is located at the crossing near L. C. Shaw's house, about 1,200 feet above the cable. The first gage established here had a chain length of 11.40 feet. It was replaced in June, 1903, by the present gage, which has a chain length of 10.75 feet from the end of the weight to the marker, but the same gage datum, It is fastened to a tree and post on the bank. The marker is the outside edge of the ring at the end of the chain. The gage is read once each day by Vernon Shaw. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the zero of the tagged wire on the left bank. The channel is straight for 300 feet above and 150 feet below the station. The right bank is high and not liable to overflow. The left bank is sloping and is liable to overflow at very high water. The bed of the stream is of sand and gravel and is not liable to scour. There is but one channel, and the current is swift near the right bank. Bench mark No. 1 is a 60-penny spike driven in a cottonwood tree located directly back of the rod. Its elevation is 12.92 feet above the zero of the gage. Bench mark No. 2 is a 60-penny spike driven in a post 1 foot in diameter and 2 feet high.

The post is set in the ground 92 feet northwest of the gage rod. Its elevation is 17.56 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of St. Mary River near Cardston, Alberta, in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec. feet.*
May 11	F. M. Brown	130	270	4.19	4.76	1,131
May 11	do	130	286	3.79	4.76	1,085
May 11	do	130	286	3.93	4.76	1,125
June 5	C. T. Prall	173	[a] 680	8.75	7.05	5,953
June 23	do	170	[a] 590	7.40	6.55	4,406
August 3	do	141	407	4.25	5.20	1,730
October 5	do	135	351	3.77	4.80	1,325
1904.						
May 10	L. R. Stockman	132	326	4.10	4.88	1,337
June 9	W. B. Freeman	161	517	6.36	6.02	3,288
July 12	Robert Follansbee	153	427	5.78	5.60	2,468
July 30	W. B. Freeman	135	318	3.81	4.82	1,213
September 3	do	123	232	2.62	4.03	608
November 19	L. R. Stockman	95	119	.80	2.45	96

[a] Recomputed, using standard section.

Mean daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.25	3.30	.....	.....	5.20	5.90	5.60	4.70	4.10	3.35	2.80	2.75
2	3.25	3.35	.....	.....	5.25	5.90	5.65	4.70	4.05	3.35	2.80	2.75
3	3.25	3.35	.....	.....	5.20	5.90	5.65	4.70	4.00	3.35	2.80	2.75
4	3.40	3.35	.....	.....	5.20	5.90	5.60	4.65	4.00	3.40	2.75	2.90
5	3.30	4.90	.....	[b] 6.15	5.05	5.90	5.60	4.65	4.00	3.40	2.70	2.90
6	3.15	5.20	.....	5.95	5.00	6.00	5.60	4.65	3.95	3.40	2.65	2.80
7	3.10	5.25	.....	5.50	5.00	6.15	5.60	4.70	3.90	3.40	2.60	2.80
8	3.10	5.10	.....	5.90	4.95	6.10	5.70	4.70	3.90	3.35	2.60	2.80
9	3.10	5.10	.....	6.15	4.90	5.95	5.65	4.75	3.90	3.35	2.65	3.00
10	3.25	5.45	.....	5.05	4.80	5.90	5.60	4.70	3.80	3.30	2.65	3.00
11	3.25	5.20	.....	4.20	4.90	5.85	5.55	4.65	3.80	3.30	2.60	3.10
12	3.25	5.30	.....	4.05	4.95	5.75	5.55	4.60	3.80	3.25	2.60	3.25
13	3.35	5.40	.....	4.05	4.90	5.60	5.40	4.50	3.80	3.25	2.60	3.00
14	3.25	5.40	.....	4.10	4.95	5.55	5.40	4.50	3.65	3.20	2.60	2.85
15	3.25	5.40	.....	4.10	5.00	5.55	5.35	4.45	3.65	3.15	2.60	2.90

[a] River frozen from January 18 to April 5. Readings to top of ice January 18 to February 22.
[b] Water running on ice April 5 to 11. Ice went out April 11.

Mean daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.20	5.40	.....	4.00	5.05	5.70	5.35	4.45	3.65	3.10	2.60	2.90
17	3.20	5.40	.....	4.05	5.15	5.90	5.25	4.40	3.65	3.10	2.60	2.95
18	3.00	5.40	.....	4.10	5.25	6.05	5.15	4.40	3.55	3.10	2.60	(a)
19	3.00	5.40	.....	4.15	5.40	6.05	5.05	4.50	3.55	3.10	2.60	3.00
20	3.00	5.35	.....	4.30	5.45	6.00	4.95	4.50	3.50	3.05	2.60	3.00
21	3.05	5.35	.....	4.40	5.55	5.95	4.90	4.50	3.50	3.00	2.75	3.10
22	3.10	.....	.....	4.45	5.90	5.90	4.85	4.45	3.50	3.00	2.75	3.30
23	3.20	.....	.....	4.45	6.00	5.90	4.85	4.40	3.45	2.95	2.80	3.60
24	3.20	.....	.....	4.50	6.05	5.75	4.85	4.20	3.55	2.90	2.80	3.60
25	3.20	.....	.....	4.50	6.00	5.70	4.85	4.20	3.50	2.90	2.80	4.10
26	3.20	.....	.....	4.60	5.80	5.55	4.85	4.10	3.50	2.85	2.80	4.10
27	3.15	.....	.....	4.70	5.70	5.50	4.85	4.00	3.45	2.85	2.80	4.10
28	3.15	.....	.....	4.90	5.60	5.50	4.80	4.05	3.45	2.85	2.80	4.05
29	3.25	.....	.....	5.00	5.70	5.45	4.80	4.10	3.40	2.85	2.80	4.05
30	3.25	.....	.....	5.05	5.75	5.50	4.75	4.00	3.40	2.85	2.80	4.15
31	3.25	.....	.....	.....	5.85	.....	4.75	4.10	.....	2.85	.....	4.45

a Ice cut for readings. River completely frozen for remainder of month.

Rating table for St. Mary River near Cardston, Alberta, from September 13, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	100	3.40	288	4.30	785	5.40	2,055
2.60	109	3.50	325	4.40	870	5.60	2,385
2.70	121	3.60	365	4.50	960	5.80	2,755
2.80	136	3.70	410	4.60	1,055	6.00	3,165
2.90	153	3.80	460	4.70	1,155	6.20	3,605
3.00	174	3.90	515	4.80	1,260	6.40	4,075
3.10	198	4.00	575	4.90	1,370	6.60	4,585
3.20	225	4.10	640	5.00	1,490	6.80	5,135
3.30	255	4.20	710	5.20	1,755	7.00	5,725

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1902, 1903, and 1904. It is well defined between gage heights 2.45 feet and 7.05 feet. The table supersedes all previous ones published.

Estimated monthly discharge of St. Mary River near Cardston, Alberta, 1902–1904.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1902.						
September	747	198	604	35,940	1.34	1.50
October	608	306	477	29,330	1.06	1.22
November	410	174	342	20,350	.76	.85
December	1,755	255	1,092	67,144	2.42	2.79
The period	.....	.....	.....	152,764	.....	.....
1903.						
January [a]	1,105	575	855	52,572	1.89	2.18
February [a]	1,155	410	913	50,705	2.02	2.10
March [a]	2,755	827	1,269	78,028	2.81	3.24
April	2,565	365	1,068	63,550	2.36	2.63
May	3,060	870	1,720	105,759	3.81	4.39
June	6,175	4,075	5,200	309,421	11.50	12.82
July	4,855	1,900	2,924	179,790	6.47	7.46
August	1,900	1,105	1,404	86,329	3.11	3.59
September	2,300	710	1,109	65,990	2.45	2.73
October	1,687	575	917	56,384	2.03	2.34
November	870	365	535	31,835	1.18	1.32
December	675	288	438	26,931	.97	1.12
The year	6,175	288	1,529	1,107,294	3.38	45.92
1904.						
January [b]	288	174	224	13,773	.50	.58
February [c]	.....	.....	200	11,504	.44	.47
March [c]	.....	.....	200	12,298	.44	.51
April [d]	.....	.....	935	55,636	2.07	2.31
May	3,273	1,260	2,022	124,328	4.47	5.15
June	3,493	2,135	2,794	166,255	6.18	6.90
July	2,565	1,208	1,860	114,367	4.12	4.75
August	1,208	575	931	57,245	2.06	2.37
September	640	288	420	24,992	.93	1.04
October	288	144	213	13,097	.47	.54
November [c]	136	109	122	7,260	.27	.30
December [c]	240	128	157	9,654	.35	.40
The year	.....	.....	840	610,409	1.86	25.32

[a] Probable ice condition January, February, and March. Rating table applied as for open channel.
[b] River frozen January 18 to 31, table applied as for open channel.
[c] Mean for month estimated by Mr. C. C. Babb.
[d] Ice gorge April 5 to 10. Mean computed from April 11 to 30 is assumed as mean for entire month.

SWIFTCURRENT CREEK NEAR ST. MARY, MONT.

This station was originally established April 8, 1902, by J. S. Baker, and was located one-half mile northwest of Henkel's ranch and 36 miles northwest of Browning, Mont. The nearest post-office is Wetzel. Henkel's ranch is reached by regular stage from Wetzel, Mont. The channel is straight for 500 feet above and 200 feet below the station. The right bank is low and liable to overflow; the left bank is high and rocky. The bed of the stream is rocky. The station as originally established by J. S. Baker was washed away by the high water in June, 1902, and was reestablished July 30, 1902, by W. W. Schlecht. The original gage was placed on the right bank of the stream. The new gage was located 1,800 feet above the first gage and on the same bank of the stream. The gage was again moved on September 27, 1902, by C. T. Prall, and located about 900 feet above the former station, as the second location was directly above a dam. The length from the pointer to the bottom of the weight was 14.60 feet. The distance from the zero of the rod to the outside of the pulley was 2.15 feet. This gage was washed out about June 10, 1903, and replaced June 17 in practically its original position by a gage having the same length of wire and the same position of pulley with reference to the scale zero as the former one. Settlement of the gage made it necessary to change the chain length, November 18, to 14.65 feet. Chain length for 1905 is 14.57. Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. At low water measurements are made by wading. The initial point for soundings was formerly on the left bank. Since September 2, 1904, it is located at a nail in the top of the upstream arm of the cable shears on the right bank. Bench mark No. 1 is a point chipped on a large bowlder 32.4 feet south of the gage. Its elevation is 12.52 feet above the zero of the gage. Bench mark No. 2 is the head of a 20-penny wire nail driven in a cottonwood tree 64.4 feet east of the gage. Its elevation is 12.86 feet above the zero of the gage. The gage is read once each day by Henry Henkel.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Swiftcurrent Creek near St. Mary, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 9	L. R. Stockman	66	108	3.70	3.10	400
June 8	W. B. Freeman	72	206	6.26	4.51	1,290
July 12	Robert Follansbee	65	145	5.03	3.66	730
July 29	W. B. Freeman	67	106	3.65	3.07	387
September 2 [a]	do	50	58	3.47	2.45	201
November 18 [b]	L. R. Stockman	11	8	4.40	1.80	36

[a] Measured from new cable station established September 2, 1904.
[b] Measured 750 feet below cable.

Mean daily gage height, in feet, of Swiftcurrent Creek near St. Mary, Mont., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					3.60	4.15	3.55	2.95	2.65	2.05	1.85	1.60
2					3.60	4.05	3.65	2.95	2.55	2.05	1.85	1.60
3					3.50	3.95	3.75	2.95	2.55	2.05	1.75	1.50
4					3.40	3.85	3.65	2.95	2.45	2.15	1.75	1.50
5				2.00	3.40	4.05	3.55	2.95	2.45	2.15	1.65	1.60
6				2.00	3.30	4.45	3.55	2.95	2.45	2.05	1.65	1.80
7				2.10	3.30	4.65	3.55	2.95	2.45	2.05	1.65	1.80
8				2.30	3.20	4.55	3.65	2.95	2.45	2.05	1.65	1.80
9				2.40	3.20	4.45	3.65	2.95	2.35	1.95	1.65	1.80
10				2.40	3.20	4.15	3.65	2.85	2.35	1.95	1.65	1.80
11				2.40	3.20	3.85	3.55	2.85	2.35	1.95	1.65	1.80
12	1.90			2.60	3.20	3.85	3.55	2.85	2.35	1.95	1.65	1.70
13	1.90			2.70	3.10	3.65	3.45	2.85	2.35	1.95	1.65	1.70
14	1.70			2.70	3.10	3.55	3.45	2.85	2.15	1.95	1.65	1.70
15	1.60			2.80	3.20	3.65	3.35	2.75	2.15	1.95	1.75	1.70
16	1.60			2.80	3.50	3.75	3.25	2.75	2.15	1.95	1.75	1.70
17	1.60			2.80	3.50	3.95	3.15	2.75	2.15	1.95	1.75	1.70
18	1.50			2.80	3.60	3.95	3.15	2.75	2.15	1.95	1.75	1.70
19	1.50			2.70	3.80	4.05	3.15	2.65	2.15	1.95	1.70	1.70
20				2.70	3.80	4.15	3.15	2.95	2.15	1.95	1.80	1.70
21				2.80	3.90	4.05	3.05	2.95	2.15	1.95	1.90	1.70
22				2.80	4.20	4.05	3.05	2.95	2.15	1.85	2.10	(b)
23				2.90	4.60	3.95	3.05	2.85	2.15	1.85	2.10	.....
24				2.90	4.20	3.85	3.05	2.85	2.05	1.75	2.10	.....
25				3.00	4.00	3.65	3.05	2.75	2.05	1.65	2.00	.....
26				3.20	3.80	3.55	2.95	2.55	2.05	1.75	2.00	.....
27				3.40	3.80	3.35	2.95	2.45	2.05	1.85	1.80	.....
28				3.60	3.70	3.35	2.95	2.45	2.05	1.85	1.70	.....
29				3.60	3.80	3.45	2.95	2.45	2.05	1.85	1.70	.....
30				3.70	3.90	3.45	2.95	2.45	2.05	1.95	1.60	.....
31				.....	4.00	.....	2.95	2.55	.....	1.95	.....	.....

[a] River frozen January 1 to April 5, with exception of January 12 to 19, when gage was read.
[b] River frozen from December 22 to 31.

Rating table for Swiftcurrent Creek near St. Mary, Mont., from June 17,[a] 1903, to December 31, 1904, superseding the table of 1903.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	14	2.70	250	3.80	880	4.90	1,745
1.60	17	2.80	285	3.90	955	5.00	1,830
1.70	24	2.90	325	4.00	1,030	5.10	1,915
1.80	36	3.00	370	4.10	1,105	5.20	2,000
1.90	52	3.10	420	4.20	1,180	5.30	2,090
2.00	70	3.20	475	4.30	1,260	5.40	2,180
2.10	90	3.30	535	4.40	1,340	5.50	2,270
2.20	112	3.40	600	4.50	1,420	5.60	2,360
2.30	136	3.50	670	4.60	1,500	5.70	2,450
2.40	162	3.60	740	4.70	1,580	5.80	2,540
2.50	190	3.70	810	4.80	1,660	5.90	2,630
2.60	219						

[a] Also applicable from April 25 to June 16, 1903, after adding 0.3 foot to gage heights, as published in Water-Supply Paper No. 100.

The above table is applicable only for open-channel conditions. It is based upon 22 discharge measurements made during 1903 and 1904. All measurements made during 1903 and 1904 have been corrected to a uniform area, using the measurement of May 9, 1904, by L. R. Stockman, as standard. With these corrections a fairly well-defined curve is obtained.

Estimated monthly discharge of Swiftcurrent Creek near St. Mary, Mont., for 1903 and 1904.[a]

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
January[b]	67	45	50	3,074	0.50	0.58
February[b]	52	45	46	2,555	.46	.48
March[b]	78	45	50	3,074	.50	.58
April	325	40	100	5,950	.99	1.10
May	1,180	162	465	28,592	4.60	5.30
June[c]	2,630	1,180	1,885	112,165	18.66	20.82
July	1,105	420	708	43,532	7.01	8.08
August	475	325	389	23,918	3.85	4.44

[a] 1902 rating table applied from January 1 to April 24, 1903. 1904 rating table applied from April 25, 1903 to December 31, 1904, after adding 0.3 foot to gage heights April 25 to June 7, 1903.
[b] Probable ice conditions. Rating table applied as for open channel.
[c] June 8-16, estimated.

Estimated monthly discharge of Swiftcurrent Creek near St. Mary, Mont., for 1903 and 1904—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
September	1,340	190	421	25,052	4.17	4.65
October	535	190	277	17,033	2.74	3.16
November	740	112	256	15,233	2.53	2.82
December[a]	219	136	166	10,207	1.64	1.89
The year	2,630	40	401	290,385	3.97	53.90
1904.						
January[b]			50	3,074	.50	.58
February[b]			40	2,301	.40	.43
March[b]			40	2,460	.40	.46
April	810	60	280	16,661	2.77	3.09
May	1,500	420	749	46,054	7.42	8.55
June	1,540	568	972	57,838	9.62	10.73
July	845	348	553	34,003	5.48	6.32
August	348	176	290	17,831	2.87	3.31
September	234	80	128	7,616	1.27	1.42
October	101	20	62	3,812	.61	.70
November[b]	90	17	36	2,142	.36	.40
December[b]	36	17	23	1,414	.23	.26
The year			269	195,206	2.66	36.25

[a] December 11–31, estimated.
[b] Means supplied by C. C. Babb. River frozen, with the exception of January 12 to 19, and November 1 to 19.

KENNEDY CREEK NEAR WETZEL, MONT.

This station was established October 17, 1903, by C. T. Prall. It is located 50 feet above the road from Altyn, Mont., to Cardston, Alberta. It is 35 miles northwest of Browning, Mont., and 20 miles from Wetzel, Mont., and about 5 miles north of the St. Mary dam site. The station is at the mouth of the canyon and about 1 mile above the mouth of Kennedy Creek. The horizontal wire gage is bolted to a tree and post on the bank of the river. The length of the wire from the end of the weight to the marker is 8.45 feet.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the zero of the tagged wire on the left bank. The channel is straight for 200 feet above and 100 feet below the station. The current is very rapid at

high stages and moderate at low stages. The right bank is rocky and may overflow at extreme high water. The left bank is high and rocky and not liable to overflow. The bed of the stream is composed of bowlders and gravel, and is probably subject to some change at high floods. Bench mark No. 1 is a chipped point on a large bowlder at the strut near the north end of the cable. Its elevation is 12.88 feet above gage datum. Bench mark No. 2 is a 60-penny spike in a cottonwood tree 90 feet north of the gage. Its elevation is 10.49 feet above gage datum. No daily gage heights were read at this station, as it was impossible to procure a reader.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Kennedy Creek near Wetzel, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec. feet.*
May 9	L. R. Stockman	51	58	2.49	6.13	145
June 8	W. B. Freeman	59	92	3.66	6.63	337
July 12	Robert Follansbee	59	81	2.04	6.40	165
July 30	W. B. Freeman	49	46	1.78	6.03	82
September 3	do	46	39	1.23	5.87	48
November 18	L. R. Stockman	37	27	.96	5.61	26

MOUSE RIVER NEAR FOXHOLM, N. DAK.

This station was established June 22, 1904, by E. F. Chandler, and is located at the highway bridge 3½ miles northeast of Foxholm, N. Dak., a flag station on the Minneapolis, St. Paul and Sault Ste. Marie Railway. A plain, vertical, staff gage is spiked to the downstream one of a row of piles that supports the bridge near the left bank. It is read once each day by H. Heinen. Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The initial point for soundings is the left end of the downstream hand rail. The channel is straight for about 300 feet above and 500 feet below the station and the current is sluggish. The right bank is covered with some brush and overflows only at extreme high water and only for a short distance. The left bank is a clean meadow. It overflows slightly during the ordinary spring floods, and in extreme floods overflows to a depth of several feet for a distance of nearly a half mile. The bed of the stream is composed of silt and mud and is not shifting. There is but one channel at ordinary stages, which during higher stages is broken by two rows of piles near each end of the bridge. The bench mark is two 12-penny nails driven into the upstream face of the pile to which the gage is

attached. Its elevation is 4.92 feet above the zero of the gage. The elevation of the zero of the gage, as determined by hand level from a Reclamation Service stake, is about 1,572 feet above sea level.

The observations at this station during 1904 have been made under the direction of E. Johnson, Jr., district hydrographer.

Discharge measurements of Mouse River near Foxholm, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 22	E. F. Chandler	66	313	1.46	4.97	459
July 14	R. Richards	63	203	1.06	3.26	215
August 13	do	63	145	.54	2.28	79
September 17	E. F. Chandler	62	142	.45	2.38	64

Mean daily gage height, in feet, of Mouse River near Foxholm, N. Dak., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.00	2.40	2.35	2.40	2.30
2		3.90	2.40	2.35	2.40	2.40
3		4.05	2.40	2.40	2.40	2.30
4		4.45	2.40	2.40	2.40	2.40
5		4.25	2.30	2.40	2.40	2.40
6		3.90	2.20	2.45	2.40	2.40
7		3.55	2.20	2.45	2.40	2.40
8		3.50	2.20	2.50	2.40	2.30
9		3.50	2.20	2.50	2.40	2.30
10		3.20	2.20	2.50	2.35	2.40
11		2.80	2.20	2.50	2.35	2.40
12		3.50	2.20	2.50	2.40	2.40
13		3.50	2.20	2.45	2.40	2.40
14		3.30	2.30	2.40	2.40	2.40
15		3.30	2.30	2.40	2.40	2.30
16		2.90	2.30	2.35	2.40	2.20
17		2.90	2.30	2.35	2.40	2.40
18		2.70	2.30	2.30	2.40	2.40
19		2.70	2.30	2.30	2.40	2.40
20		3.20	2.30	2.30	2.40	(a)
21		3.20	2.30	2.30	2.45	(a)
22		2.90	2.30	2.25	2.45	(a)
23	4.90	2.80	2.30	2.25	2.40	(a)
24	4.80	2.90	2.30	2.22	2.40	(a)
25	4.60	2.80	2.30	2.25	2.40	(a)
26	4.50	2.60	2.30	2.25	2.30	(a)
27	4.40	2.60	2.30	2.30	2.30	(a)
28	4.35	2.60	2.30	2.30	2.40	(a)
29	4.30	2.50	2.30	2.35	2.40	(a)
30	4.05	2.40	2.30	2.40	2.40	(a)
31		2.40	2.35		2.40	(a)

a River frozen from November 20 to December 31.

MOUSE RIVER AT MINOT, N. DAK.

This station was established May 5, 1903, by F. E. Weymouth. It is located at the footbridge, 150 feet northwest of the Great Northern Railway roundhouse at Minot, N. Dak. The gage is a vertical 1 by 6 inch board, 20 feet long, nailed to a pile of the center pier of the bridge on the downstream side. It is read once each day by H. E. Wheeler. Discharge measurements are made from the downstream side of the bridge, at which the gage is located. The bridge makes an angle of 15° with the normal to the direction of the current, which has to be taken into account in computing discharge measurements. The initial point for soundings is the zero mark on the downstream guard rail at the electric-light pole on the right bank. The channel is straight for 100 feet above and below the station. The current has a moderate velocity. Both banks are high, covered with trees and shrubs, and will not overflow. The bed of the stream is composed of sand and is fairly constant. There are some snags and brush in the bottom of the channel. Bench mark No. 1 is the top of the hydrant at the corner of the street, about 150 feet north of the bridge. Its elevation is 21.83 feet above the zero of the gage. Bench mark No. 2 is the top of the hydrant one block west of bench mark No. 1. This elevation is 21.85 feet above the zero of the gage. Bench mark No. 3 is the top of the rail of the side track at the southwest corner of the roundhouse. Its elevation is 24.18 feet above the zero of the gage. The top of the rail of the main track of the Great Northern Railway station has an elevation of 24.49 feet above the zero of the gage. As determined by connection with railroad levels, the zero of the gage has an elevation of 1,540 feet above sea level. The drainage area of Mouse River at this station is 8,400 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Mouse River near Minot, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 17	E. F. Chandler	170	1,880	1.65	17.92	3,107
April 30	do	1,668	4,391	1.83	20.48	8,056
May 31	R. Richards	118	1,267	1.44	14.68	1,824
June 22	E. F. Chandler	88	400	1.74	6.69	698
June 24	do	87	373	1.54	6.32	577
July 13	R. Richards	83	291	.96	5.16	279
July 14	do	83	299	1.04	5.29	312
August 12	do	77	220	.46	4.40	102
September 18	E. F. Chandler	74	220	.40	4.30	88

Mean daily gage height, in feet, of Mouse River near Minot, N. Dak., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	20.3	13.9	5.8	4.6	4.4	4.2	4.2
2	.....	20.2	11.7	5.7	4.6	4.3	4.2	4.2
3	6.0	20.1	10.5	5.6	4.5	4.3	4.2	4.2
4	7.0	20.0	9.7	5.6	4.5	4.3	4.25	4.15
5	9.3	19.9	9.5	5.5	4.5	4.3	4.3	4.15
6	10.6	19.9	9.2	5.3	4.5	4.3	4.25	4.15
7	11.3	19.9	9.0	5.1	4.5	4.3	4.25	4.15
8	12.8	19.9	8.8	5.1	4.4	4.3	4.25	4.15
9	13.8	19.9	8.7	5.1	4.4	4.3	4.25	4.15
10	14.2	19.9	8.6	5.0	4.4	4.3	4.25	4.15
11	14.8	19.8	8.5	5.0	4.4	4.3	4.25	4.15
12	15.7	19.8	8.4	5.0	4.4	4.3	4.25	4.15
13	16.0	19.8	8.1	5.0	4.4	4.3	4.2	4.1
14	16.4	19.7	8.0	5.0	4.4	4.3	4.2	4.1
15	16.8	19.4	7.8	5.0	4.4	4.3	4.2	4.1
16	17.2	19.2	7.7	5.0	4.4	4.3	4.2	4.1
17	18.1	19.0	7.5	5.0	4.4	4.3	4.2	4.1
18	18.6	18.9	7.2	5.0	4.4	4.3	4.25	4.3
19	19.0	18.7	7.0	5.0	4.4	4.3	4.25	4.3
20	[a]21.9	18.6	7.0	5.0	4.4	4.25	4.2	4.25
21	21.8	18.4	6.9	5.0	4.4	4.25	4.2	4.25
22	21.7	18.2	6.7	5.0	4.4	4.25	4.2	4.25
23	21.5	18.0	6.6	5.0	4.4	4.2	4.2	4.25
24	21.3	17.9	6.4	5.0	4.4	4.2	4.2	4.2
25	21.0	17.5	6.2	5.0	4.4	4.2	4.2	4.2
26	20.9	17.1	6.1	4.9	4.4	4.2	4.2	[b]
27	20.8	16.8	6.0	4.9	4.4	4.2	4.2	[b]
28	20.7	16.4	6.0	4.8	4.4	4.2	4.2	[b]
29	20.6	16.2	5.9	4.7	4.4	4.2	4.2	[b]
30	20.6	15.0	5.8	4.7	4.4	4.2	4.2	[b]
31	.....	14.5	.....	4.6	4.4	.....	4.2	.....

[a] From April 20 to 30 the river rose above the gage. The heights are estimated from observer's report and high-water marks.
[b] Frozen.

DES LACS RIVER AT FOXHOLM, N. DAK.

This station was established June 23, 1904, by E. F. Chandler. It is located at the highway bridge at Foxholm, a station on the Minneapolis, St. Paul and Sault Ste. Marie Railway. A plain staff gage, graduated to feet and tenths, is nailed to the downstream side of the first pier from the left bank. This pier is composed of a row of piles parallel to the bank of the stream. The gage is read once each day by L. S. Alden. Discharge measurements are made from the downstream side of the highway bridge to which the gage is attached. The initial point for soundings is the right end of the downstream hand rail. The channel is straight for about 75 feet above and 25 feet below the station. There is but one channel at ordinary stages. During high water the channel is divided by the piling piers of the bridge. The current is sluggish at low stages. The right bank is high, covered with brush, and does not overflow. The left bank is covered with brush and does not overflow except in high floods, when the water may pass across a neck a few rods east of the bridge. The bed

of the stream is composed of silt and mud, and is slightly shifting. The bench mark is a group of four spikes driven into the pile beside the gage rod. Its elevation is 10.00 feet above the zero of the gage, as obtained by hand level from the railroad, is 1,633 feet above sea level.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Des Lacs River at Foxholm, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 23	E. F. Chandler	18	51	0.80	3.80	41
July 13	R. Richards	18	41	.58	3.12	24
August 12	do	18	30	.32	2.45	9.6
September 17[a]	E. F. Chandler	14	4.5	1.10	2.22	5.0
September 17	do	18	23	.28	2.22	6.2

[a] Measurements by wading.

Mean daily gage height, in feet, of Des Lacs River at Foxholm, N. Dak., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.[a]	Dec.[a]
1		3.50	2.72	2.00	2.28	2.10	
2		3.50	2.70	2.00	2.28	2.15	
3		3.45	2.70	2.00	2.29	2.18	
4		3.40	2.70	2.10	2.31	2.20	
5		3.40	2.68	2.10	2.33	2.22	
6		3.35	2.68	2.10	2.35	2.25	
7		3.30	2.55	2.15	2.35	2.25	
8		3.25	2.54	2.19	2.38	2.23	
9		3.25	2.52	2.19	2.40	2.21	
10		3.20	2.50	2.18	2.40	2.20	[b]2.35
11		3.20	2.48	2.18	2.40	2.20	
12		3.15	2.45	2.15	2.40	2.00	
13		3.15	2.42	2.20	2.40	2.00	
14		3.25	2.40	2.20	2.40	1.96	
15		3.45	2.35	2.20	2.40	1.98	
16		3.20	2.32	2.22	2.40	1.95	
17		3.15	2.30	2.21	2.40	1.95	[c]2.30
18		3.10	2.28	2.21	2.40	1.92	
19		3.05	2.25	2.21	2.40	1.90	
20		3.00	2.25	2.20	2.40	1.90	
21		2.97	2.27	2.20	2.40	1.90	
22		2.95	2.25	2.20	2.40	1.90	
23	3.80	2.90	2.25	2.20	2.42	1.90	
24	3.80	2.87	2.25	2.21	2.40	1.90	
25	3.75	2.84	2.25	2.21	2.35	[d]	[e]2.30
26	3.75	2.80	2.22	2.22	2.30	1.90	
27	3.70	2.80	2.20	2.25	2.25		
28	3.65	2.75	2.20	2.25	2.15		
29	3.60	2.75	2.20	2.26	2.10		
30	3.55	2.75	2.00	2.28	2.05		
31		2.73	2.00		2.05		[f]2.30

[a] Gage heights read to water surface during frozen period.
[b] Ice 4 inches thick.
[c] Ice 6 inches thick.
[d] River frozen over.
[e] Ice 10 inches thick.
[f] Ice 13 inches thick.

Rating table for Des Lacs River at Foxholm, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	2	2.40	9	2.90	19	3.40	29
2.00	3	2.50	11	3.00	21	3.50	32
2.10	4	2.60	13	3.10	23	3.60	35
2.20	5	2.70	15	3.20	25	3.70	38
2.30	7	2.80	17	3.30	27	3.80	41

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is well defined between gage heights 2.2 feet and 3.8 feet.

Estimated monthly discharge of Des Lacs River at Foxholm, N. Dak., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 23–30	41	34	38.1	605
July	32	16	23.3	1,433
August	15.3	3	8.8	540
September	6.6	3	4.9	290
October	9	3.5	7.8	477
November 1–24	6	2	3.6	173

RED RIVER AT FARGO, N. DAK.

This station was established May 27, 1901, by C. M. Hall, and is located at the bridge connecting Front street, Fargo, N. Dak., and Main street, Moorhead, Minn. The gage consists of a 1 by 8 inch board, painted white, graduated to feet and tenths in black, and attached to the east side of the breakwater for the center pier of the bridge. The zero of the gage is 44.45 feet below the top of the plank walk of the bridge over the gage and is 860.9 feet above sea level, the elevation having been determined by leveling from the top of rail of Northern Pacific Railway station, Moorhead, Minn. The observer is H. R. Grasse, United States Weather Bureau, Moorhead, Minn. Discharge measurements were originally made from the bridge to which the gage is attached, but owing to unfavorable conditions for accurate measurement the measuring section was changed June 10, 1904, to the footbridge at the Fargo waterworks, one-half mile upstream from the gage, except at unusually high stages, when measurements are made from the Northern Pacific Railway bridge, 15 rods

below the gage. A movable timber and stay cable, enabling the meter to be held about 7 feet horizontally upstream from the footbridge, obviates the influence of the small piling piers. This equipment is stored in the pump house of the waterworks. The initial point at the footbridge is an electric-light pole on the right bank. The initial point at the railway bridge is the right end of the draw span. The channel is straight for about 100 feet above and 150 feet below the station, and the current is medium. The left bank is high and steep, while the right bank is low and subject to overflow at times of high water. The bed of the stream is composed of silt and mud and is fairly permanent. There is but one channel at all stages. The bench mark is a point on the extreme north end of the flat top of the concrete pier of the railway bridge at the initial point for soundings. Its elevation is 37.12 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Red River at Fargo, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 14[a]	E. F. Chandler	124	1,064	2.13	15.97	2,269
May 10[b]	do	107	638	1.87	10.59	1,193
May 10[c]	do	109	610	1.95	10.59	1,190
June 6[c]	do	95	493	1.88	10.18	925
June 10[c]	do	108	588	1.84	10.40	1,082
June 10[b]	E. C. Murphy	92	592	1.82	10.38	1,076
June 27[c]	E. F. Chandler and R. Richards.	128	1,114	2.37	14.38	2,642
July 6[c]	R. Richards	113	724	1.93	11.44	1,404
July 30[c]	do	101	429	1.50	8.88	643
October 17[c]	do	98	357	1.44	8.22	516

[a] Backwater due to ice jams. [b] Front Street Bridge.
[c] Regular station at waterworks bridge.

Mean daily gage height, in feet, of Red River at Fargo, N. Dak., for 1904.

Day.	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		11.3	12.0	9.8	13.7	8.8	7.7	8.0	8.1
2		11.0	11.2	9.8	13.0	8.7	7.8	8.0	8.1
3		11.3	10.8	9.8	12.5	8.6	7.8	8.1	8.1
4		11.5	10.5	10.0	12.0	8.6	8.0	8.2	8.1
5		11.7	10.5	10.1	11.6	8.5	8.2	8.2	8.0
6		11.7	10.4	10.1	11.3	8.5	8.3	8.2	8.0
7		11.9	10.4	10.1	11.1	8.5	8.3	8.2	8.0
8		12.4	10.4	10.1	11.1	8.5	8.3	8.2	8.0
9		11.7	10.5	10.2	10.8	8.4	8.3	8.2	8.0

[a] River frozen during March and December.

Mean daily gage height, in feet, of Red River at Fargo, N. Dak., for 1904—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
10	.....	11.8	10.6	10.5	10.7	8.4	8.2	8.2	8.0
11	.....	12.2	10.6	10.5	10.6	8.3	8.2	8.2	8.0
12	.....	12.9	10.6	10.5	10.7	8.3	8.2	8.3	8.0
13	.....	14.0	10.5	10.4	10.8	8.3	8.1	8.2	8.0
14	.....	15.8	10.6	10.3	10.8	8.3	8.1	8.2	8.0
15	8.6	17.8	10.6	10.1	10.6	8.3	8.0	8.2	8.0
16	8.6	19.0	10.1	10.0	10.4	8.3	8.0	8.2	8.0
17	8.6	19.7	10.0	9.9	10.4	8.3	8.0	8.3	8.0
18	8.6	20.5	9.9	9.8	10.2	8.3	8.0	8.3	8.0
19	8.6	21.2	9.8	9.7	10.0	8.3	8.0	8.3	8.0
20	8.6	21.3	9.7	9.7	9.9	8.2	8.0	8.2	8.0
21	8.6	20.9	9.7	9.6	9.9	8.2	8.0	8.2	8.0
22	8.7	20.2	9.7	9.5	9.5	8.1	8.0	8.2	8.0
23	8.7	19.5	9.7	9.5	9.4	8.1	8.0	8.2	8.0
24	9.3	18.5	9.7	10.5	9.2	8.0	8.0	8.2	8.0
25	9.5	17.7	9.8	11.5	9.0	8.0	8.0	8.3	8.0
26	9.5	16.7	9.8	13.3	9.0	8.0	8.0	8.3	8.0
27	9.5	16.0	9.8	14.5	9.0	7.9	7.9	8.2	7.7
28	9.5	15.0	9.8	14.8	8.9	7.8	7.9	8.2	7.4
29	9.5	13.7	9.9	14.8	8.9	7.8	7.9	8.2	7.0
30	10.3	12.8	9.9	14.4	8.8	7.7	7.9	8.1	7.2
31	10.9	.....	9.9	.....	8.8	7.7	.....	8.1	.....

Rating table for Red River at Fargo, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.00	231	8.40	536	9.80	907	11.40	1,422
7.10	252	8.50	560	9.90	936	11.60	1,496
7.20	273	8.60	585	10.00	966	11.80	1,572
7.30	294	8.70	610	10.10	996	12.00	1,650
7.40	315	8.80	636	10.20	1,026	12.20	1,730
7.50	336	8.90	662	10.30	1,057	12.40	1,811
7.60	357	9.00	688	10.40	1,088	12.60	1,893
7.70	378	9.10	714	10.50	1,119	12.80	1,976
7.80	400	9.20	741	10.60	1,151	13.00	2,060
7.90	422	9.30	768	10.70	1,183	14.00	2,480
8.00	444	9.40	795	10.80	1,215	15.00	2,920
8.10	466	9.50	822	10.90	1,248		
8.20	489	9.60	850	11.00	1,281		
8.30	512	9.70	878	11.20	1,350		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined between gage heights 7 feet and 11.5 feet. Above gage height 11.50 the extension of the curve is determined by a measurement at 14.4 feet gage height. Discharges applied to gage heights above 15 feet are approximate estimates.

Estimated monthly discharge of Red River at Fargo, N. Dak., for 1904.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	6,089	1,281	3,222	191,700	0.537	0.599
May	1,650	878	1,043	64,130	.174	.201
June	2,832	822	1,268	75,460	.211	.235
July	2,354	636	1,124	69,120	.187	.216
August	636	378	502	30,870	.084	.097
September	512	378	452	26,900	.075	.084
October	512	444	488	30,010	.081	.093
November	466	231	428	25,470	.071	.079
The period				513,700		

RED RIVER AT GRAND FORKS, N. DAK.

This station was established May 26, 1901, by C. M. Hall. It is located at the Northern Pacific Railway bridge at Grand Forks, N. Dak. The original gage is a vertical 1 by 8 inch board attached to the north end of the breakwater of the middle bridge pier. The zero of this gage was placed 5 feet below the zero of the United States Army engineers' gage, which is attached to the same breakwater. A standard chain gage has been established with the same datum as the vertical gage and is attached to the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 50.44 feet. The gage is read once each day by Philip Hayes. Discharge measurements are made from the Great Northern Railway bridge, about one-fifth mile above the gage. The initial point for soundings is marked in red paint on the downstream guard rail at the left end of the left span. The channel is straight for 500 feet above and for 150 feet below the Great Northern Railway bridge. The current has a moderate velocity. The right bank is liable to overflow at high stages and is wooded. The left bank will overflow only at very high stages and for a short distance. The water at all stages will pass beneath the 4-span bridge and its trestle approaches. The bed of the stream is composed of sand and mud and is subject to some change. The water is usually heavily laden with sediment from Red Lake River, which enters one-half mile above the station. Bench mark No. 1 is the north corner of the iron plates of the turntable near the center of the middle pier of the Northern Pacific Railway bridge. The bench mark is on the north side, about 1 inch above the surface of the stone pier. Its elevation is 43.95 feet above gage datum. Bench mark No. 2 is a spike in a telegraph pole in the lumber yard southwest of the left end of the bridge, from which it is 200 feet distant. Its elevation is 48.50

feet above gage datum. The top of the pulley of the chain gage is 53.12 feet above gage datum. Gage datum is 45.58 feet above the city datum of Grand Forks and is 777.9 feet above sea level.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Red River at Grand Forks, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 12	R. Richards	665	11,560	1.81	35.74	20,970
April 25	E. F. Chandler	908	16,130	1.99	39.92	32,040
May 9	R. Richards	307	5,338	2.56	25.09	13,640
May 23	E. F. Chandler	207	2,814	2.95	17.10	8,292
June 9	E. C. Murphy	192	2,313	2.79	14.55	6,442
August 18	R. Richards	155	876	1.91	6.62	1,674
October 3	E. F. Chandler	150	868	1.74	6.48	1,510

Mean daily gage height, in feet, of Red River at Grand Forks, N. Dak., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	10.45	38.45	14.22	14.21	7.85	6.45	6.48	6.98	.....
2	.....	.....	.....	12.85	37.28	14.05	14.10	7.76	6.60	6.58	6.93	.....
3	.....	.....	.....	15.90	35.88	13.88	13.80	7.61	6.76	6.55	7.08	[a]6.40
4	.....	.....	.....	19.90	33.90	13.72	13.44	7.80	6.75	6.70	6.95	.....
5	.....	.....	.....	24.45	31.62	13.90	12.90	7.80	6.80	6.78	6.90	.....
6	.....	.....	.....	28.55	29.25	13.92	12.38	7.58	6.82	6.91	6.88	.....
7	7.7	7.3	7.1	31.42	27.35	14.05	12.20	7.50	7.10	6.60	6.92	[a]6.40
8	.....	.....	.....	34.35	25.88	14.28	11.78	7.35	7.12	6.88	6.88	.....
9	.....	.....	.....	35.32	25.20	14.58	11.56	7.28	7.04	6.80	6.68	.....
10	.....	.....	.....	35.68	24.98	14.70	11.38	7.10	7.00	6.85	6.92	.....
11	.....	.....	.....	35.90	24.85	14.80	11.02	6.90	6.82	7.22	6.88	.....
12	.....	.....	.....	35.80	24.74	14.90	10.80	6.90	6.70	6.92	6.82	.....
13	.....	.....	.....	35.75	24.38	14.82	10.68	6.98	6.55	6.98	6.75	.....
14	7.5	7.2	7.4	35.90	23.78	14.72	10.46	6.89	6.69	7.10	6.62	[a]6.30
15	.....	.....	.....	[b]35.88	23.10	14.50	10.40	6.79	6.60	7.22	6.52	.....
16	.....	.....	.....	35.34	22.38	14.05	10.12	6.83	6.45	7.25	6.65	.....
17	.....	.....	.....	35.74	21.65	13.78	10.23	6.61	6.60	7.35	6.78	.....
18	.....	.....	.....	35.52	20.75	13.72	10.21	6.60	6.32	7.40	6.82	.....
19	.....	.....	.....	34.70	19.90	13.70	10.02	6.70	6.45	7.22	6.85	.....
20	.....	.....	.....	35.20	19.12	13.78	9.93	6.52	6.32	7.25	6.75	.....
21	7.8	7.0	7.65	35.92	18.42	13.70	9.70	6.50	6.61	7.58	6.60	[a]6.40
22	.....	.....	.....	36.58	17.78	13.32	9.46	6.41	6.58	7.32	6.78	.....
23	.....	.....	.....	37.70	17.05	13.10	9.28	6.49	6.38	7.48	6.60	.....
24	.....	.....	.....	38.88	16.50	12.82	9.08	6.59	6.38	7.28	6.78	.....
25	.....	.....	.....	39.90	16.22	12.55	8.90	6.54	6.48	7.48	6.72	.....
26	.....	.....	.....	40.50	15.85	12.44	8.70	6.42	6.38	7.32	6.68	.....
27	.....	.....	.....	40.62	15.60	12.42	8.55	6.38	6.45	7.26	7.20	.....
28	.....	.....	.....	40.40	15.38	13.05	8.36	6.39	6.50	7.05	(a)	.....
29	.....	6.95	.....	39.98	15.05	13.84	8.20	6.15	6.52	7.42	(a)	.....
30	.....	.....	.....	39.38	14.78	14.19	8.40	6.05	6.48	7.15	6.50	.....
31	7.3	.....	9.75	.....	14.39	.....	8.08	6.29	.....	7.02	.....	[a]6.50

[a] River frozen at gage; readings to surface of water; ice 3.5 to 14 inches thick.
[b] Ice running April 15.

NOTE.—During January, February, and March gage read to surface of water; ice 26 inches thick.

Rating table for Red River at Grand Forks, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	1,300	8.20	2,470	10.80	4,010	17.00	8,290
6.10	1,350	8.30	2,525	11.00	4,130	17.50	8,665
6.20	1,400	8.40	2,580	11.20	4,260	18.00	9,040
6.30	1,450	8.50	2,635	11.40	4,390	18.50	9,420
6.40	1,500	8.60	2,690	11.60	4,520	19.00	9,820
6.50	1,550	8.70	2,750	11.80	4,650	19.50	10,220
6.60	1,600	8.80	2,810	12.00	4,780	20.00	10,620
6.70	1,650	8.90	2,870	12.20	4,910	21.00	11,440
6.80	1,700	9.00	2,930	12.40	5,040	22.00	12,290
6.90	1,755	9.10	2,990	12.60	5,170	23.00	13,140
7.00	1,810	9.20	3,050	12.80	5,300	24.00	14,020
7.10	1,865	9.30	3,110	13.00	5,430	25.00	14,920
7.20	1,920	9.40	3,170	13.20	5,560	26.00	15,870
7.30	1,975	9.50	3,230	13.40	5,700	27.00	16,840
7.40	2,030	9.60	3,290	13.60	5,840	28.00	17,840
7.50	2,085	9.70	3,350	13.80	5,980	29.00	18,880
7.60	2,140	9.80	3,410	14.00	6,120	30.00	19,960
7.70	2,195	9.90	3,470	14.50	6,470	31.00	21,080
7.80	2,250	10.00	3,530	15.00	6,820	32.00	22,240
7.90	2,305	10.20	3,650	15.50	7,170	33.00	23,440
8.00	2,360	10.40	3,770	16.00	7,540	34.00	24,650
8.10	2,415	10.60	3,890	16.50	7,915		

The above table is applicable only for open-channel conditions. It is based upon 16 discharge measurements made during 1903 and 1904. It is well defined between gage heights 5 feet and 18 feet. Above 18 feet a measurement at 39.92 feet determines the direction of the curve. The table has been extended beyond these limits. Above gage height 34 feet the rating curve is a tangent, the difference being 125 per tenth.

Estimated monthly discharge of Red River at Grand Forks, N. Dak., for 1904.

[Drainage area, 25,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 15–30	32,920	25,520	29,200	926,700	1.13	0.673
May	30,210	6,393	13,720	843,600	.532	.613
June	6,750	5,053	6,020	358,200	.233	.260
July	6,267	2,404	3,914	240,700	.152	.175
August	2,278	1,325	1,758	108,100	.068	.078
September	1,876	1,460	1,613	95,980	.062	.069
October	2,074	1,540	1,854	114,000	.072	.083
November, 28 days	1,920	1,550	1,704	94,640	.066	.069
The period				2,782,000		

OTTER TAIL RIVER NEAR FERGUS FALLS, MINN.

This station was established May 9, 1904, by E. F. Chandler. It is located at Three-Mile Bridge, about 3½ miles northeast of Fergus Falls, Minn. The temporary gage is a 2 by 6 inch timber graduated by feet and tenths from 1 to 6.2 feet, and marked with brass-headed nails driven into the bank near the lower corner of the left abutment. Gravel covers the rod to the 2.2-foot mark. The gage is read once each day by H. G. Evensen, jr. Discharge measurements are made from the lower side of the single-span steel highway bridge at which the gage is placed. The initial point for soundings is the left end of the downstream hand rail. Ten-foot intervals are marked along the rail with brass-headed nails. The channel is straight for about 150 feet above and for 600 feet below the station. The current is medium at all stages. Both banks are high, wooded, and do not overflow. The bed of the stream is composed of clean gravel and small stones, and is probably permanent except after extreme floods. There is one channel at ordinary stages, and two possible at high water. The chief source of supply is Otter Tail Lake; therefore sudden fluctuations in river height are not to be expected. The bench mark is a nail driven into the stone wing wall of the left abutment, downstream side, about 4½ feet from the angle of the abutment and just behind the temporary gage. Its elevation is 5.56 feet above the zero of the gage.

The observations have been made during 1904 under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Otter Tail River near Fergus Falls, Minn., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 9	E. F. Chandler	97	197	2.50	3.54	491
June 4	do	97	222	3.08	3.74	684
June 11	E. C. Murphy	97	221	2.93	3.70	647
July 23	R. Richards	97	187	2.48	3.34	464
August 20	do	98	163	2.14	3.07	348
September 26	E. F. Chandler	98	146	2.16	2.98	316

Mean daily gage height, in feet, of Otter Tail River near Fergus Falls, Minn., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.65	3.8	3.3	3.05	3.0	3.05	.....
2	.....	3.65	3.75	3.25	3.1	3.0	3.05	.....
3	.....	3.75	3.75	3.25	3.1	3.0	3.05	.....
4	.....	3.8	3.7	3.25	3.1	3.0	3.05	.....
5	.....	3.85	3.7	3.25	3.1	3.0	3.05	.....
6	.....	3.85	3.65	3.25	3.1	3.0	3.05	.....
7	.....	3.8	3.6	3.25	3.05	3.0	3.05	.....
8	.....	3.8	3.55	3.25	3.05	3.0	3.0	.....
9	3.55	3.75	3.55	3.2	3.05	3.0	3.0	.....
10	3.55	3.7	3.55	3.2	3.05	3.0	3.0	.....
11	3.5	3.7	3.55	3.2	3.05	3.0	3.0	.....
12	3.45	3.7	3.5	3.15	3.05	3.0	3.0	.....
13	3.5	3.7	3.5	3.15	3.05	3.0	3.0	.....
14	3.55	3.75	3.5	3.15	3.0	3.0	3.0	.....
15	3.55	3.75	3.45	3.15	3.0	3.05	3.0	.....
16	3.55	3.75	3.4	3.15	3.0	3.05	3.0	.....
17	3.5	3.65	3.4	3.1	3.0	3.05	3.0	.....
18	3.5	3.65	3.5	3.1	3.0	3.05	3.0	.....
19	3.55	3.65	3.5	3.1	3.0	3.05	3.0	.....
20	3.55	3.6	3.45	3.1	3.0	3.05	3.0	.....
21	3.6	3.6	3.45	3.1	3.0	3.0	3.0	.....
22	3.65	3.6	3.4	3.1	3.0	3.0	3.0	(a)
23	3.65	4.2	3.35	3.1	3.0	3.0	3.05	.....
24	3.7	3.9	3.35	3.05	3.0	3.0	3.05	.....
25	3.7	3.85	3.35	3.05	3.0	3.0	3.05	.....
26	3.65	3.8	3.3	3.05	3.0	3.05	3.05	.....
27	3.65	3.8	3.3	3.05	3.0	3.05	3.05	.....
28	3.65	3.75	3.35	3.05	3.0	3.05	3.10	.....
29	3.65	3.8	3.35	3.05	3.0	3.05	(b)	.....
30	3.65	3.8	3.3	3.05	3.0	3.05	.....	.....
31	3.7	.....	3.3	3.05	.....	3.05	.....	.....

a Ice 16 inches thick December 22. b River frozen over November 29.

Rating table for Otter Tail River near Fergus Falls, Minn., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	320	3.40	456	3.70	650	4.00	905
3.10	350	3.50	500	3.80	735	4.10	990
3.20	383	3.60	568	3.90	820	4.20	1,075
3.30	418						

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined between gage heights 3.0 feet and 3.75 feet. The table has been extended above gage height 3.75 feet.

Estimated monthly discharge of Otter Tail River near Fergus Falls, Minn., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May (9–31)	650	478	565	25,780
June	1,075	568	696	41,420
July	735	418	513	31,540
August	418	335	365	22,440
September	350	320	329	19,580
October	335	320	326	20,040
November (1–28)	350	320	328	18,220

SHEYENNE RIVER NEAR HAGGART, N. DAK.

This station was established March 22, 1902, by C. M. Hall. It is located near the way station of Haggart, on the Northern Pacific Railway, 5 miles west of Fargo, N. Dak., at a private wagon bridge about one-fourth of a mile north of the railroad. The gage is a vertical 1 by 6 inch board fastened to the piling pier at the middle of the bridge, divided into feet and tenths, and reads up to 17 feet. It is read once each day by John C. Haggart. Discharge measurements are made from the same bridge. The initial point for soundings is the end of the hand rail on the lower side of the bridge, right bank. The channel is straight for 30 feet above and 200 feet below the station and the current moderate. Both banks are steep and not liable to overflow except in unusual floods. There is a single channel at all stages and its bed is of clay and only slightly shifting.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Sheyenne River near Haggart, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-Feet.*
April 14	E. F. Chandler	76	824	1.44	15.45	1,186
May 10	do	79	957	1.84	17.08	1,763
June 6	do	49	207	2.01	7.14	415
June 10	E. C. Murphy	52	230	1.93	7.19	443
June 27	E. F. Chandler	50	189	1.83	6.32	348
July 30	R. Richards	46	98	1.78	4.41	175
October 17	do	46	94	1.14	4.19	107

Mean daily gage height, in feet, of Sheyenne River near Haggart, N. Dak., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	12.05	18.40	6.50	6.00	4.20	3.90	4.00	3.95	[a] 4.00
2	.....	12.40	18.40	6.50	5.90	4.40	4.20	3.90	3.80	4.00
3	.....	12.85	18.35	6.40	5.90	4.38	3.90	3.80	3.90	4.00
4	.....	12.85	18.30	6.50	5.80	4.30	3.90	3.90	3.95	.....
5	.....	13.05	18.20	6.60	5.70	4.10	3.30	4.10	3.90	.....
6	.....	12.90	18.15	7.30	5.70	4.00	3.90	4.10	3.90	.....
7	.....	12.50	18.05	7.20	5.60	4.00	3.90	3.90	3.90	.....
8	.....	11.90	17.70	6.90	5.50	3.88	3.90	3.80	3.80	.....
9	.....	12.45	17.25	6.90	5.40	3.90	3.80	4.50	3.85	.....
10	.....	12.85	16.85	7.50	5.20	4.10	3.60	4.60	3.80	.....
11	.....	13.15	15.40	7.60	5.10	4.05	3.00	4.30	3.90	.....
12	.....	14.00	13.25	8.50	5.50	3.98	3.70	4.10	4.00	.....
13	.....	[b] 15.10	11.75	8.50	5.30	3.92	4.00	3.90	4.10	.....
14	.....	15.70	10.65	9.00	5.40	3.95	3.90	3.80	3.90	.....
15	.....	16.00	10.15	9.00	5.40	3.75	4.15	4.00	4.00	.....
16	.....	15.50	9.65	8.90	5.50	3.82	3.95	3.90	3.90	.....
17	.....	15.85	9.15	8.70	5.50	3.98	4.00	3.90	4.10	.....
18	.....	16.80	8.80	8.10	5.40	3.95	3.90	3.90	4.00	.....
19	.....	17.75	8.40	7.80	5.70	3.85	3.80	3.85	3.90	.....
20	.....	18.10	8.15	6.30	5.50	3.90	3.60	3.90	4.00	.....
21	.....	18.15	7.90	6.50	5.30	3.95	3.90	3.90	4.10	.....
22	(c)	[b] 18.60	7.70	6.00	5.20	3.95	4.00	3.90	3.90	.....
23	.....	18.45	7.60	5.90	4.90	3.20	4.10	3.90	4.00	.....
24	6.00	18.40	7.45	6.20	4.70	3.90	4.00	3.85	3.90	.....
25	6.20	18.40	7.40	6.40	4.50	3.80	3.80	3.80	4.10	.....
26	[d] 6.30	18.40	7.30	6.30	4.70	3.60	3.90	3.90	4.10	.....
27	7.90	18.40	7.25	6.20	4.60	3.50	3.90	3.95	4.00	.....
28	9.40	18.40	7.20	6.00	4.55	3.80	4.00	3.85	3.90	.....
29	9.40	18.40	7.05	6.00	4.40	3.70	3.90	3.90	4.00	.....
30	[e] 10.35	18.40	6.85	6.00	4.70	3.10	4.00	3.90	[f] 4.00	.....
31	11.40	.....	6.65	.....	4.60	3.80	.....	3.80	.....	.....

[a] Ice 6 inches thick.
[b] Ice jam.
[c] Ice 3 feet thick.
[d] 4 inches of water on top of ice.
[e] Ice breaks up.
[f] Ice 1 inch thick.

Rating table for Sheyenne River near Haggart, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	32	4.70	157	6.40	340	9.00	654
3.10	36	4.80	167	6.50	351	9.20	680
3.20	41	4.90	177	6.60	362	9.40	706
3.30	47	5.00	187	6.70	373	9.60	732
3.40	53	5.10	197	6.80	384	9.80	758
3.50	59	5.20	208	6.90	396	10.00	784
3.60	66	5.30	219	7.00	408	10.50	849
3.70	73	5.40	230	7.20	432	11.00	914
3.80	80	5.50	241	7.40	456	11.50	980
3.90	87	5.60	252	7.60	480	12.00	1,050
4.00	95	5.70	263	7.80	504	13.00	1,190
4.10	103	5.80	274	8.00	528	14.00	1,330
4.20	112	5.90	285	8.20	552	15.00	1,470
4.30	121	6.00	296	8.40	576	16.00	1,610
4.40	130	6.10	307	8.60	602	17.00	1,750
4.50	139	6.20	318	8.70	615	18.00	1,890
4.60	148	6.30	329	8.80	628	19.00	2,030

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is not well defined. Above gage height 12.0 feet the rating curve is a tangent, the difference being 14 per tenth.

Estimated monthly discharge of Sheyenne River near Haggart, N. Dak., for 1904.

[Drainage area, 5,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April[a]	1,974	1,036	1,553	92,410	0.288	0.321
May	1,946	368	1,043	64,130	.193	.222
June	654	285	420	24,990	.078	.087
July	296	130	217	13,340	.040	.046
August	130	36	88	5,411	.016	.018
September	112	32	85.1	5,064	.016	.018
October	148	80	93.2	5,731	.017	.020
November	103	80	91.3	5,433	.017	.019
The period				216,500		

[a] During the greater part of April backwater was caused by ice gorge. Estimate for the month probably somewhat large.

RED LAKE RIVER AT CROOKSTON, MINN.

This station was established May 19, 1901, by C. M. Hall. It is located at the bridge which connects Robert and St. Paul streets, and which is known as the Sampson Addition Bridge. It is about one-sixth mile west of the Great Northern Railway station. The low-water vertical gage is a 1 by 6 inch board, graduated to feet and tenths, fastened to the piling of the left abutment under the bridge. It reads from 0 to 9.6 feet. The high-water vertical gage is attached to the piling of the pier at the right end of the bridge. It reads from 7.5 to 15 feet. There is also a wire gage near the middle of the single-span bridge. Its horizontal scale reads from 3 to 19 feet. The gage is read once each day by J. E. Carroll, the city engineer. Discharge measurements are made from the lower side of the single-span bridge at which the gages are located. The initial point for soundings is the post of the hand rail, lower side, at the left end of the bridge, at a point where the diagonal member of the bridge truss meets the floor timbers. The channel is straight for 250 feet above and 200 feet below the station. The current is swift. The right bank is low and is covered with trees and brush. It is liable to overflow at very high stages, but there would be little current in the flooded section, owing to the trees and brush. The left bank is high, wooded, and not liable to overflow. The bed of the stream is sandy, free from vegetation, and shifting. The dam and power house for the city waterworks are located about 1,000 feet above the gage. The opening and closing of the sluices cause some variation in the flow, but the gage readings represent a close average of the daily river height. Bench mark No. 1 is the top of the hydrant at the corner of St. Paul and Robert streets, 30 feet south of the bridge. Its elevation is 24.23 feet above gage datum. Bench mark No. 2 is the top of a hydrant 200 feet north of the bridge at the corner of St. Paul and Woodlawn streets. Its elevation is 27.46 feet above the zero of the gage. The city datum of Crookston has an elevation of 4.10 feet above gage datum. The top of the rail of the main track at the Great Northern Railway station at Crookston has an elevation of 37.63 feet above gage datum. The gage datum has an elevation of 825 feet above sea level.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Red Lake River at Crookston, Minn., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 15	E. F. Chandler	193	2,535	2.33	16.50	5,915
April 26	do	203	3,007	3.98	18.46	11,970
May 16	R. Richards	201	1,693	3.65	11.58	6,184
June 9	E. C. Murphy	183	1,077	3.23	8.48	3,486
July 16	R. Richards	177	671	2.76	6.26	1,854
August 17	do	173	357	2.13	4.40	759
September 9	do	176	526	2.21	5.36	1,164
October 24	do	177	498	2.44	5.20	1,208

Mean daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					13.32	8.65	7.35	5.33	5.60	4.40	5.05	3.80
2					12.42	8.40	7.25	5.30	5.40	5.10	5.00	4.10
3				8.80	11.95	8.25	7.15	5.00	5.35	4.50	4.85	3.70
4				11.55	11.30	8.38	6.95	5.30	5.40	5.00	4.75	3.80
5				15.68	10.90	8.55	6.90	5.28	5.30	4.85	.....	3.70
6				18.03	10.55	8.55	7.10	5.10	5.60	4.85	4.60	4.50
7				18.30	11.35	8.60	6.70	4.50	5.35	5.00	4.50	4.70
8				17.01	11.90	8.80	6.80	4.90	5.35	4.50	5.00	4.65
9				15.12	11.90	8.85	6.65	4.92	5.40	5.15	5.20	4.80
10				13.93	11.90	8.70	6.15	4.70	5.35	4.60	5.40	4.80
11				15.42	11.60	8.60	6.45	4.55	4.70	4.75	5.15	4.70
12				17.90	11.68	8.60	6.45	4.50	5.10	4.75	4.85	5.05
13				16.85	11.68	8.70	6.35	4.50	4.60	4.93	4.85	5.50
14				16.55	11.95	8.10	6.15	4.75	4.70	4.63	5.00	5.30
15				16.35	11.80	7.85	5.85	4.70	4.85	5.10	5.05	5.60
16				15.85	11.80	7.75	6.35	4.50	4.85	4.50	5.15	5.40
17				15.47	11.40	7.75	5.95	4.53	4.25	4.70	.....	5.50
18				13.08	10.80	8.00	6.20	4.60	4.20	4.90	4.80	5.40
19				14.85	10.67	8.60	5.95	4.63	4.15	4.75	4.60	5.40
20				12.72	10.40	8.50	5.65	4.63	4.90	4.80	.....	5.50
21				13.30	10.10	8.05	5.55	4.45	4.05	5.05	4.40	5.65
22				15.10	9.20	8.05	5.60	4.60	4.40	4.93	4.20	5.65
23				[b]19.13	9.82	8.10	5.58	4.65	4.58	5.05	.....	5.00
24				20.32	9.52	7.95	5.70	4.65	4.80	5.15	4.30	5.10
25				19.50	9.50	7.90	5.58	4.55	4.50	4.80	4.10	5.10
26				18.30	9.30	8.00	5.65	4.70	4.60	5.10	4.25	5.10
27				16.40	9.30	8.15	5.60	4.50	4.80	5.10	3.60	(c)
28				15.65	9.30	7.80	5.40	4.65	4.35	5.10	3.70	.....
29				15.05	8.85	7.60	5.32	4.30	4.45	5.40	3.90	.....
30				13.90	8.70	7.75	5.15	4.50	4.90	5.20	3.90	.....
31				.....	8.78	.....	5.00	4.90	.....	4.60	.....	.....

[a] River frozen over from January 1 to April 2.
[b] Rise at the rate of 1¼ inches per hour during day.
[c] Channel frozen underneath gage, 20 feet channel open.

Rating table for Red Lake River at Crookston, Minn., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	430	5.00	1,090	6.40	1,980	8.60	3,620
3.70	470	5.10	1,150	6.50	2,050	8.80	3,780
3.80	510	5.20	1,210	6.60	2,120	9.00	3,950
3.90	550	5.30	1,270	6.70	2,190	10.00	4,800
4.00	590	5.40	1,330	6.80	2,260	11.00	5,650
4.10	630	5.50	1,390	6.90	2,330	12.00	6,500
4.20	670	5.60	1,450	7.00	2,400	13.00	7,350
4.30	710	5.70	1,510	7.20	2,540	14.00	8,200
4.40	760	5.80	1,570	7.40	2,680	15.00	9,050
4.50	810	5.90	1,630	7.60	2,820	16.00	9,900
4.60	860	6.00	1,700	7.80	2,980	17.00	10,750
4.70	910	6.10	1,770	8.00	3,140	18.00	11,600
4.80	970	6.20	1,840	8.20	3,300	19.00	12,450
4.90	1,030	6.30	1,910	8.40	3,460	20.00	13,300

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is fairly defined. Above gage height 9 feet the rating curve is a tangent, the difference being 85 per tenth.

Estimated monthly discharge of Red Lake River at Crookston, Minn., for 1904.

[Drainage area, 5,525 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 3–30	13,570	3,780	7,410	411,500	1.34	1.40
May	7,622	3,700	5,446	334,900	.986	1.14
June	3,822	2,820	3,341	198,800	.605	.675
July	2,645	1,090	1,817	111,700	.329	.379
August	1,288	710	938	57,680	.170	.196
September	1,450	610	1,020	60,690	.185	.206
October	1,330	760	1,021	62,780	.185	.213
November	1,330	430	893	53,140	.162	.181
December 1–26	1,480	470	1,059	54,610	.192	.186
The period				1,346,000		

PEMBINA RIVER NEAR NECHE, N. DAK.

This station was established April 29, 1903, by F. E. Weymouth, assisted by E. F. Chandler. At this time a temporary gage was put in. The permanent gage was installed by E. F. Chandler May 18, 1903. It is located at the Great Northern Railway bridge, two-thirds of a mile north of the railroad station at Neche, N. Dak. The gage is near the northeast corner of sec. 36, T. 164 N., R. 54 W. It consists of two sections of 1 by 6 inch plank painted white and divided into feet and tenths. The lower section, reading from 0 to 5 feet, is driven 2 feet into the bed of the stream, and has its upper end spiked to the bridge abutment timbers on the left bank. The upper section, reading from 5 to 24 feet, is spiked to the bridge pier on the right bank. It is read once each day by P. J. Horgan. Discharge measurements are made from the single-span highway bridge, 400 feet below the gage. The initial point for soundings is a point on the downstream hand rail 3 feet from its right end. The bridge crosses the river obliquely. To take this fact into account, the hand rail has been divided into intervals of 10.4 feet. This is equivalent to 10-foot intervals of a cross section normal to the direction of the current. The channel is straight for 100 feet above and below the station. Both banks extend about 20 feet above the zero of the gage. They are not liable to overflow except at exceptionally high stages. The right bank is densely wooded and the left bank is covered with brush. The bed of the stream is composed of sand and of mud, in which there are some sunken snags. The bed may change slightly. About one-third of a mile below the gage there is a loose-rock dam 4 feet high. This raises the water 1 or 2 feet at the bridge, but, as the dam is not tight, the water may fall at low stages. Bench mark No. 1 is the top of the horizontal timber on the upstream side of the right pier, near the gage. It is marked with brass-headed nails, and has an elevation of 23.70 feet above the zero of the gage. Bench mark No. 2 is the west rail of the track at the rail joint at the crossing about 550 feet south of the gage. Its elevation is 26.54 feet above the zero of the gage. Bench mark No. 3 is a spike driven in the north face of the telephone pole inside the fence in the field west of the track and about 550 feet south of the gage. It is about 1½ feet above the ground and has an elevation of 24.28 feet above the zero of the gage. The elevation of the top of the 12 by 12 inch timber, to which the low-water gage is fastened, is 4.93 feet. The elevation of the zero of the gage above sea level, as determined by hand level from the railroad station at Neche, N. Dak., is 815 feet. The drainage area of Pembina River at this station is 2,800 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Pembina River near Neche, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 18	R. Richards	85	634	1.93	11.85	1,227
April 26	do	92	1,494	2.14	18.12	3,198
May 23	do	96	909	2.45	13.28	2,230
June 8	E. C. Murphy	86	837	2.12	12.04	1,778
July 9	R. Richards	79	488	1.99	8.51	971
August 16	do	72	299	1.22	5.70	363
October 17	L. L. Wilcox	70	274	.91	5.22	249

Mean daily gage height, in feet, of Pembina River near Neche, N. Dak., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					20.7	10.2	8.1	6.0	5.5	5.0	5.0	
2					20.9	9.9	7.9	6.0	5.5	5.0	5.0	
3					20.7	9.9	8.9	6.0	5.5	5.0	5.0	
4				3.7	20.3	9.9	15.2	6.0	5.5	5.0	5.0	
5				3.8	19.9	14.0	16.0	6.0	5.5	5.0	5.0	
6				4.0	19.3	13.8	11.8	6.0	5.5	5.0	5.0	
7				4.5	18.6	13.3	9.7	6.0	5.5	5.0	5.0	
8				5.0	18.0	12.0	9.5	6.0	5.5	5.0	5.0	
9				[b]7.0	17.4	11.0	8.6	6.0	5.5	5.0	5.0	
10				9.3	16.8	11.8	8.0	6.0	5.5	5.0	5.0	
11				9.4	16.4	13.8	7.8	5.9	5.5	5.0	5.0	
12				10.0	16.0	15.2	7.6	5.9	5.5	5.0	5.0	
13				11.7	16.5	15.3	7.6	5.8	5.5	5.0	5.0	
14				12.2	16.9	14.0	7.3	5.8	5.4	5.0	4.9	
15				13.5	17.5	12.8	7.0	5.8	5.4	5.0	4.9	
16				13.8	17.7	12.0	6.9	5.8	5.4	5.0	4.8	
17				12.9	16.3	11.3	6.9	5.8	5.3	5.0	4.7	
18				11.8	15.4	10.5	6.9	5.7	5.3	5.1	4.6	
19				12.4	14.6	10.4	6.8	5.7	5.4	5.2	4.5	
20				15.3	14.1	9.7	6.8	5.7	5.4	5.2	4.5	
21				16.2	13.9	9.5	6.8	5.9	5.5	5.3	4.5	
22				16.8	13.3	13.1	6.8	5.9	5.5	5.3	4.5	
23				17.0	13.3	13.2	6.7	5.9	5.5	5.3	4.5	
24				17.8	13.0	13.4	6.5	5.9	5.5	5.3	4.5	
25				18.0	12.5	12.7	6.2	5.8	5.5	5.3	4.5	
26				18.2	12.0	11.1	6.0	5.7	5.4	5.3	4.5	
27				18.2	11.8	10.3	6.0	5.7	5.4	5.3	[a]	
28				18.3	11.4	9.1	6.0	5.6	5.3	5.2		
29				19.0	11.1	8.4	5.9	5.5	5.2	5.1		
30				19.7	10.8	8.3	6.0	5.5	5.1	5.0		
31					10.5		6.0	5.5		5.0		

[a] River frozen January 1 to April 8 and November 27 to December 31, inclusive.
[b] Ice broken up.

Miscellaneous measurements in the Hudson Bay drainage basin (St. Mary River subdrainage basin) in 1904.

[Under the direction of C. C. Babb, district engineer.]

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Discharge.
			Sq. feet.	*Ft. per sec.*	*Sec.-feet.*
July 12	St. Mary canal.	Kimballward, Alta	71	2.35	167
July 30	do	do	68	2.37	161

MINNESOTA RIVER DRAINAGE BASIN.

Minnesota River rises in Bigstone Lake, which forms part of the boundary between South Dakota and Minnesota. The river flows in a southeasterly direction to the city of Mankato, in the northern part of Blue Earth County, where it makes an abrupt turn to the north and continues in a northerly and northeasterly direction, entering Mississippi River at a point midway between Minneapolis and St. Paul.

The course of this river is generally marked by wide bottom lands. It has a sluggish current, affording few opportunities for the development of water power. The United States Geological Survey maintains a gaging station at Mankato, below the junction of Blue Earth River, mainly for the study of the sewage disposal of the city of Mankato, and for the purpose of ascertaining the run-off in the southern part of Minnesota.

MINNESOTA RIVER ABOVE MANKATO, MINN.

This station was established May 20, 1903, by E. Johnson, jr., assisted by W. R. Hoag. It is located at Sibley Park, 1 mile below the highway and railroad bridges across Blue Earth River and 1½ miles above the city bridge in Mankato. The drainage area above the station is about 13,400 square miles. Blue Earth River joins the Minnesota about 500 feet above the station. The gage is a vertical timber, divided into feet and tenths, fastened to a post, which is driven into the river bed a few feet from the right bank. It is read once each day by George E. Blake. On February 4, 1904, a new $\frac{5}{16}$-inch galvanized cable was stretched across the river between trees on the banks. The old ¼-inch wire cable from which measurements were previously made was left undisturbed and will be used as a tag line. The new cable is wound with heavy wire every 25 feet. The first point at which wire is wound is 17.34 feet from the tree to which the cable is attached. Discharge measurements are made from a small rowboat running on this cable. The initial point for soundings is a spike in the base of the willow tree to which the small cable is attached

on the right bank; it is about 15 feet from the top of the bank. The channel is straight for 1,000 feet above and 2,000 feet below the station. The current velocity is moderate, though somewhat sluggish near the banks at low stages. The width of the channel is about 300 feet at low water and about 350 feet at high stages. The right bank is low and liable to overflow for a distance of 50 to 75 feet from the gage. The left bank is a steep, rocky bluff. The bed of the stream is composed of sand, gravel, and blue earth, and may shift somewhat at high water. There is but one channel at all stages. The bench mark is on a 20-inch cottonwood tree on the right bank, a short distance above the station and about 30 feet from the water's edge. Its elevation is 14.78 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Minnesota River above Mankato, Minn., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 17	E. Johnson, jr	365	1,133	0.51	2.30	580
April 21	E. F. Chandler	302	2,004	2.45	6.48	4,909
June 28	do	286	1,039	2.09	3.74	2,172
July 26	R. Richards	282	773	1.41	2.70	1,092
August 31	do	270	614	.89	2.09	548
October 18	E. F. Chandler	270	616	1.08	2.24	665
December 30	R. Richards	220	498	.63	[a]2.20	315

[a] Gage height of under surface of ice = 1.70.

Mean daily gage height, in feet, of Minnesota River above Mankato, Minn., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	2.00	2.00	5.20	6.40	3.45	3.50	2.75	2.10	1.90	2.60	2.15
2	3.10	2.00	2.00	5.10	6.15	3.50	3.40	2.70	2.40	1.90	2.55	2.15
3	2.10	2.00	2.00	4.95	6.00	3.60	3.35	2.60	2.55	1.90	2.55	2.15
4	2.90	2.00	2.00	4.90	5.80	3.85	3.30	2.50	2.40	1.90	2.55	[a]2.10
5	2.85	2.00	2.00	4.90	5.60	4.80	3.25	2.45	2.40	1.90	2.50	2.10
6	2.70	2.00	2.10	4.80	5.65	4.90	3.20	2.40	2.35	1.90	2.50	2.10
7	2.50	2.00	2.20	4.70	5.70	4.20	3.10	2.35	2.30	1.90	2.50	2.10
8	2.40	2.00	2.30	4.60	5.60	4.20	3.05	2.35	2.30	1.90	2.45	2.10
9	2.35	2.00	2.45	5.60	5.50	4.25	3.00	2.50	2.30	1.90	2.45	2.10
10	2.30	2.00	2.40	6.70	5.40	4.25	3.10	2.55	2.20	2.00	2.45	2.10
11	2.25	2.00	2.50	7.60	5.30	4.25	3.10	2.50	2.20	2.10	2.40	2.10
12	2.25	2.00	2.60	8.30	5.10	4.20	3.00	2.40	2.20	2.10	2.40	2.10
13	2.20	2.00	2.70	8.30	5.00	4.15	3.00	2.40	2.15	2.10	2.40	2.10
14	2.20	2.00	2.80	8.10	4.90	4.10	3.00	2.30	2.10	2.10	2.40	2.10
15	2.15	2.00	2.90	7.85	4.70	4.00	2.90	2.30	2.10	2.10	2.40	2.00
16	2.15	2.00	3.00	7.60	4.60	3.80	2.80	2.30	2.10	2.10	2.40	2.00
17	2.10	2.00	3.00	7.40	4.50	3.70	2.70	2.30	2.10	2.10	2.30	2.00
18	2.10	2.00	[b]3.10	7.10	4.35	3.70	2.70	2.25	2.00	2.20	2.30	2.00

[a] River frozen. [b] Ice unbroken.

Mean daily gage height, in feet, of Minnesota River above Mankato, Minn., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
19	2.10	2.00	3.10	6.90	4.20	3.60	2.70	2.25	2.00	2.30	2.30	2.00
20	2.00	2.00	4.00	6.70	4.15	3.60	2.60	2.20	2.00	2.55	2.30	2.00
21	2.00	2.00	4.10	6.50	4.10	3.55	2.60	2.20	2.00	2.70	2.30	1.80
22	2.00	2.00	4.20	6.70	4.00	3.50	2.55	2.20	2.00	2.80	2.30	1.80
23	2.00	2.00	4.30	7.10	3.95	3.45	2.50	2.15	2.00	2.85	2.30	1.80
24	2.00	2.00	4.50	7.40	3.90	3.50	2.50	2.10	2.00	2.80	2.30	1.80
25	2.00	2.00	4.60	7.40	3.80	3.55	2.50	2.10	1.90	2.80	2.25	1.80
26	2.00	2.00	4.70	7.30	3.80	3.75	2.70	2.00	1.90	2.75	2.25	1.80
27	2.00	2.00	5.00	7.30	3.70	3.80	2.65	2.00	1.90	2.70	2.20	1.80
28	2.00	2.00	5.10	7.10	3.65	3.75	2.60	2.00	1.90	2.70	2.20	2.20
29	2.00	2.00	5.20	6.80	3.60	3.70	2.60	2.00	1.90	2.70	2.20	2.20
30	2.00	.....	5.20	6.65	3.55	3.60	2.75	2.00	1.90	2.70	2.20	2.20
31	2.00	.....	5.25	.....	3.50	.....	2.80	2.00	.....	2.65	.....	2.20

WAPSIPINICON RIVER DRAINAGE BASIN.

Wapsipinicon River rises in Mower County, Minn., and flows southeast, entering the Mississippi near Shaffton, Scott County, Iowa. There are numerous small power sites on this stream at Toronto, Oxford Mills, Newport, Anamosa, Central City, Troy Mills, Quasqueton, Independence, and Littleton. At several of these points, notably at Anamosa, there are good opportunities for building dams.

The river is generally fairly constant in its flow, though its headwaters are sometimes low. As a rule, its banks are fairly high and the stream is well confined. The United States Geological Survey maintains a gaging station at Stone City.

The total drainage area of the Wapsipinicon River is 2,304 square miles; that at Stone City, where the United States Geological Survey has its station, is 1,308 square miles.

WAPSIPINICON RIVER AT STONE CITY, IOWA.

This station was established August 19, 1903, by F. W. Hanna. It is located at the highway bridge just above the Chicago, Milwaukee and St. Paul Railway bridge and near the Dearborn stone quarry. There is a dam at Waubeck, 4 miles above the station, and another at Anamosa, the same distance below. A standard boxed chain gage is attached to the guard rail on the upstream side of the bridge. The length of the chain from the end of the weight to the marker is 36.4 feet. The gage is read once each day by Frank Dearborn. Discharge measurements are made from the two-span Pratt truss highway bridge, which has a length of 225 feet. The initial point for soundings is the end of the lower chord on the upstream side of the bridge at the left bank. The channel is straight for about 400 feet above and below the station, at which points the river makes abrupt turns. Both banks

are high and are not subject to overflow. The bed of the stream is of solid rock and sand and is permanent. The channel is broken by one pier, and the current velocity is moderate. Bench mark No. 1 is the east end of the south rail west of the first switch east of the railroad station at Stone City. Its elevation is 815.08 feet above sea level and 38.75 feet above gage datum. Bench mark No. 2 is a cross on the northwest corner of the middle pier of the highway bridge at which the station is located. Its elevation is 31.09 feet above gage datum and 807.42 feet above sea level. The center of the gage pulley is at an elevation of 35.58 feet above gage datum and 811.91 feet above sea level. The top of the lower chord, upstream side, at the first cross girder east of the pier is 31.75 feet above gage datum. The elevations of the bench marks above sea level have been determined by Chicago, Milwaukee and St. Paul Railway levels. During the spring of 1904 a new railroad bridge was erected 100 feet below the station. The two new piers of the bridge changed the station conditions to such an extent that the measurements prior to June 7 are not comparable to those for the remainder of the year.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Wapsipinicon River at Stone City, Iowa, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 14 [a]	F. W. Hanna	125	190	0.50	1.54	96
March 16 [b]	do	158	342	1.60	4.60	547
April 20	do	139	485	1.32	3.70	641
May 26	Hanna and Johnson	139	436	.64	3.30	281
June 7	F. W. Hanna	139	509	1.11	3.80	567
July 12	do	139	384	.98	3.31	377
August 16	do	131	248	.44	2.36	108
September 6	do	137	295	.61	2.72	180
October 22	E. Johnson, jr	136	296	.53	2.68	156
November 12	F. W. Hanna	132	226	.41	2.44	93

[a] River frozen. Gage height to under surface of ice.
[b] Ice conditions.

Mean daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	.....	[b]4.58	5.62	3.90	5.05	3.30	2.55	2.32	2.40	2.48	2.18
2	.....	.....	4.55	5.27	3.76	4.65	3.30	2.52	2.42	2.36	2.46	2.25
3	.....	.....	4.92	4.97	3.68	5.45	3.45	2.50	2.50	2.40	2.46	2.25
4	.....	[c]2.6	5.57	4.47	3.63	4.95	3.50	2.45	2.42	2.43	2.43	(d)
5	.....	2.9	5.92	4.32	3.57	4.10	3.40	2.42	2.50	2.46	2.46	.....
6	.....	[b]4.8	[e]5.8	4.15	3.48	3.95	3.75	2.40	2.70	2.46	2.48	.....
7	.....	[f]4.7	5.7	4.10	3.56	3.90	3.90	2.37	2.75	2.48	2.46	[g]2.23
8	2.4	4.8	5.0	4.32	3.60	3.90	3.75	2.35	2.80	2.46	2.42	.....
9	.....	4.2	4.9	4.58	3.68	3.85	3.60	2.32	2.70	2.76	2.41	.....
10	.....	4.1	4.9	4.82	3.58	3.60	3.45	2.30	2.64	2.58	2.36	.....
11	.....	4.0	4.7	4.92	3.48	3.45	3.40	2.40	2.60	2.51	2.32	.....
12	(h)	3.9	4.6	4.62	3.43	3.37	3.30	2.42	2.58	2.48	2.36	.....
13	.....	[i]3.9	4.6	4.27	3.58	3.30	3.27	2.55	2.57	2.46	2.38	.....
14	2.8	3.8	4.6	4.12	3.73	3.22	3.25	2.48	2.52	2.46	2.35	[j]2.28
15	.....	3.7	4.6	4.02	3.66	3.15	3.20	2.45	2.54	2.46	2.35	.....
16	.....	3.7	4.6	4.00	3.55	3.27	3.10	2.40	2.51	2.56	2.40	.....
17	(h)	3.6	5.0	3.96	3.40	3.20	3.02	2.38	2.48	2.81	2.55	.....
18	.....	.....	5.38	3.92	3.33	3.20	3.00	2.40	2.48	2.76	2.52	.....
19	.....	.....	[k]6.45	3.82	3.30	3.20	2.95	2.48	2.43	2.76	2.44	.....
20	.....	3.6	7.55	3.70	3.30	3.15	2.90	2.45	2.43	2.74	2.42	.....
21	2.8	.....	[l]9.60	3.66	3.25	3.70	2.87	2.52	2.40	2.71	2.40	[m]2.4
22	.....	3.6	7.75	3.60	3.25	3.70	2.82	2.54	2.35	2.68	2.42	.....
23	.....	.....	7.70	3.55	3.20	3.60	2.78	2.48	2.40	2.70	2.46	.....
24	(c)	.....	7.95	3.62	3.15	3.50	2.75	2.40	2.38	2.68	2.50	.....
25	.....	.....	8.70	4.05	3.40	3.45	2.72	2.40	2.46	2.65	2.52	.....
26	.....	3.6	10.05	4.62	3.50	3.50	2.80	2.35	2.48	2.60	2.55	.....
27	.....	3.6	11.70	4.96	3.55	3.45	2.75	2.30	2.48	2.55	2.50	.....
28	.....	4.40	11.45	4.85	4.65	3.35	2.70	2.28	2.53	2.50	2.35	.....
29	.....	3.70	9.55	4.58	5.50	3.30	2.68	2.42	2.48	2.48	2.18	.....
30	2.6	.....	6.75	4.25	6.45	3.35	2.65	2.40	2.46	2.48	2.15	[m]2.2
31	.....	.....	6.15	.....	6.05	.....	2.60	2.35	.....	2.48	.....	.....

[a] Ice 14 inches thick.
[b] Measured to water running over ice.
[c] Ice 16 to 24 inches thick.
[d] Ice 3.5 inches thick.
[e] Ice 18 inches thick.
[f] Ice broken up.
[g] Ice 3.5 inches thick.
[h] Ice 16 inches thick.
[i] Ice about 16 inches thick.
[j] Ice 5.5 inches thick.
[k] Ice breaking up.
[l] Ice went out.
[m] Ice 10.5 inches thick.

NOTE.—Gage heights to surface of water.

Rating table for Wapsipinicon River at Stone City, Iowa, from June 7 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	50	2.80	203	3.40	398	4.00	660
2.30	73	2.90	232	3.50	436	4.10	712
2.40	97	3.00	262	3.60	476	4.20	766
2.50	122	3.10	294	3.70	518		
2.60	148	3.20	327	3.80	563		
2.70	175	3.30	362	3.90	610		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is well defined between gage heights 2.40 feet and 3.80 feet. The table has been extended beyond these limits. (See note in station description.)

Estimated monthly discharge of Wapsipinicon River at Stone City, Iowa, for 1904.

[Drainage area, 1,308 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
June 7–30	610	310	420	0.321	0.286
July	610	148	313	.239	.276
August	135	68	102	.078	.090
September	203	78	125	.096	.107
October	206	87	138	.106	.122
November	135	39	102	.078	.087

IOWA RIVER DRAINAGE BASIN.

Iowa River rises in the north-central part of Iowa, flows in a southeasterly direction, and joins Mississippi River about 30 miles above Burlington. Its chief tributary is Cedar River, which rises in Minnesota and flows into the Iowa about 50 miles above the latter's mouth.

The total drainage area of Iowa River is 12,410 square miles, 4,470 square miles of this being tributary to it above its junction with Cedar River at Columbus Junction. Its drainage areas at Marshalltown and Iowa City are, respectively, 1,463 and 3,317 square miles. Cedar River drains 7,597 square miles above its union with Iowa River and 6,317 square miles at Cedar Rapids.

The chief power plants in the Iowa River drainage basin are at Iowa City, Marshalltown, Cedar Rapids, Waterloo, and Cedar Falls. From the standpoint of power development the Iowa River system is important.

During 1904 stations have been maintained on Cedar River at Cedar Rapids, Iowa, and on Iowa River at Iowa City, Iowa.

IOWA RIVER AT IOWA CITY, IOWA.

This station was established June 1, 1903, by F. W. Hanna. At that time a chain gage was installed on the county bridge directly west of the State University grounds. On September 15, 1903, the standard boxed chain gage was substituted for the gage which was first established and made to read the same, with the same length of chain from the end of the weight to the marker. This length is 24.43 feet. On June 8, 1904, the length of the weight and chain to the marker was changed to 26.48 feet, the gage datum remaining the same. The gage is read twice each day by Arthur G. Smith. Discharge measurements are made from the upstream side of the two-span highway bridge at the foot of Burlington street, about 1,000 feet below the bridge at which the gage is located. The initial point for soundings is the inner face of the right abutment, located at the west end of the bridge, and is marked zero on the bridge floor. The bridge is not quite at right-angles with the direction of the current. The channel is straight for about 1,600 feet above and below the station. The channel is 316 feet wide between abutments, and is broken by one pier. The bed of the stream is of soft material, except near the bridge pier, and is slightly shifting. The right bank is high and somewhat rocky and not liable to overflow. The left bank does not overflow, owing to the road embankment. Both banks are covered with willows above ordinary high-water mark, which will interfere with flood measurements. Bench mark No. 1 is on the top stone just north of and against the northwest railing post of the bridge at which the gage is located. Its elevation above gage datum is 22.67 feet, and above the city datum is 64.72 feet and 672.06 feet above sea level. The city bench mark used for reference is on the north side of the base of a maple tree, one block east and one block and 40 feet south of the bridge at which the gage is located. The elevation of this bench mark is 22.53 feet above gage datum, 64.58 feet above the city datum, and 671.92 feet above sea level. The elevation above sea level was obtained from the levels of the Chicago, Rock Island and Pacific Railway. The bottom of the top hand rail, just above the pulley center, has an elevation of 26.73 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Iowa River at Iowa City, Iowa, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 15[a]	F. W. Hanna	162	460	0.38	−1.54	175
April 20	do	211	980	1.53	1.30	1,500
May 27	Johnson and Hanna	187	817	1.11	.37	908
June 8	F. W. Hanna	213	1,051	1.59	1.59	1,846
July 12	do	188	833	1.24	.46	1,033
August 17	do	165	567	.57	−1.26	321
September 7	do	183	754	1.04	.00	784
October 21	E. Johnson, jr	159	490	.40	−1.41	198
November 13	F. W. Hanna	162	492	.37	−1.46	184

[a] River frozen.

Mean daily gage height, in feet, of Iowa River at Iowa City, Iowa, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[b]
1			3.25	1.95	2.86	2.3	0.95	−0.97	−1.25	−1.4	−1.45	−1.7
2			3.15	1.65	2.51	2.15	.97	− .92	− .7	−1.45	−1.3	−1.8
3			3.3	1.55	2.21	1.9	.75	− .87	− .9	−1.5	−1.4	−1.7
4			3.35	1.4	1.96	1.9	.65	−1.10	−1.1	−1.45	−1.35	−1.8
5		3.2	3.7	1.18	1.66	1.45	.55	−1.12	− .9	−1.35	−1.38	−1.4
6		4.95	3.2	1.05	1.46	1.3	.50	−1.12	− .2	−1.3	−1.4	−1.6
7		3.0	2.75	1.0	1.76	1.45	.55	−1.27	− .1	−1.25	−1.3	−1.7
8			2.4	1.65	2.16	1.6	.45	−1.27	− .2	−1.35	−1.45	−1.7
9	−0.27		2.1	1.5	2.41	1.7	1.00	−1.07	− .3	−1.15	−1.3	−1.6
10			1.9	1.55	1.86	1.7	.90	−1.24	− .45	−1.2	−1.4	−1.6
11			1.6	1.72	1.56	1.65	.62	−1.35	− .5	−1.25	−1.5	−1.7
12			1.15	2.05	1.36	1.45	.44	−1.43	− .65	−1.25	−1.3	−1.7
13		1.1	1.1	1.8	1.66	1.25	.52	−1.3	− .65	−1.3	−1.45	−1.3
14			1.0	1.85	1.51	1.2	.62	−1.4	− .8	−1.3	−1.35	
15			0.5		1.56	.9	.87	−1.3	− .9	−1.35	−1.5	
16	− .20		0.4		1.39	.8	.27	−1.3	−1.0	−1.3	−1.1	
17			3.15		1.29	.65	.92	−1.3	−1.0	−1.35	−1.4	−1.6
18			1.95	1.7	1.14	.5	− .08	−1.3	−1.1	−1.25	−1.45	
19			2.7	1.55	.99	.45	.07	−1.32	−1.1	−1.1	−1.2	
20		.1	2.45	1.33	.94	.45	.02	−1.38	−1.1	−1.25	−1.45	
21	[c]3.68		2.25	1.13	.84	.53	.15	−1.4	−1.1	−1.3	−1.3	
22	2.00		2.8	1.13	.69	.30	.60	−1.1	−1.15	−1.45	−1.6	
23	.70		2.95	1.50	.64	.13	.65	−1.1	−1.2	−1.5	−1.5	−1.8
24	.70		3.4	2.93	.39	.33	.3	−1.2	−1.05	−1.5	−1.2	−1.6
25			7.8	4.68	.39	1.13	− .05	−1.25	−1.25	−1.55	−1.6	−1.7
26			4.8	5.28	.44	1.23	− .25	−1.35	−1.35	−1.3	−1.7	−1.6
27		.1	4.4	4.33	.39	1.03	− .3	−1.35	−1.15	−1.45	−1.5	
28			4.42	4.68	.78	.93	− .38	−1.4	−1.3	−1.35	−1.5	
29		[c]4.25	3.1	4.83	1.2	1.13	− .6	−1.0	−1.3	−1.35	−1.6	
30	[d]− .30		2.15	4.28	1.6	1.23	− .6	− .9	−1.4	−1.45	−1.4	
31			2.1		2.05		− .8	−1.25		−1.45		[e]−1.4

[a] River frozen January 1 to March 24, inclusive.
[b] River frozen at station December 1 to 31, inclusive.
[c] Heavy thaw.
[d] Ice 21 inches thick.
[e] Ice 6 inches thick.

NOTE.—Gage heights read to water surface during frozen period.

Rating table for Iowa River at Iowa City, Iowa, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.70	160	.00	680	1.70	1,780	4.80	4,920
−1.60	179	.10	730	1.80	1,860	5.00	5,160
−1.50	199	.20	780	1.90	1,950	5.50	5,785
−1.40	220	.30	830	2.00	2,040	6.00	6,410
−1.30	242	.40	880	2.20	2,220	6.50	7,085
−1.20	266	.50	940	2.40	2,400	7.00	7,760
−1.10	292	.60	1,000	2.60	2,580	7.50	8,460
−1.00	320	.70	1,060	2.80	2,780	8.00	9,160
−.90	350	.80	1,120	3.00	2,980	8.50	9,885
−.80	380	.90	1,180	3.20	3,180	9.00	10,610
−.70	410	1.00	1,250	3.40	3,380	9.50	11,360
−.60	445	1.10	1,320	3.60	3,580	10.00	12,110
−.50	480	1.20	1,390	3.80	3,800	11.00	13,610
−.40	520	1.30	1,460	4.00	4,020	12.00	15,210
−.30	560	1.40	1,540	4.20	4,240	13.00	16,810
−.20	600	1.50	1,620	4.40	4,460	14.00	18,410
−.10	640	1.60	1,700	4.60	4,680	15.00	20,010

The above table is applicable only for open-channel conditions. It is based upon 18 discharge measurements made during 1903 and 1904. It is well defined between gage heights −1.40 feet and 2.40 feet. Two flood measurements define the table above gage height 2.40 feet. It is the same as the 1903 table above 5.0 feet.

Estimated monthly discharge of Iowa River at Iowa City, Iowa, for 1904.

[Drainage area, 3,317 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March, 7 days	8,880	2,130	4,304	1.30	0.338
April [a]	5,510	1,250	2,330	.702	.783
May	2,840	875	1,590	.479	.552
June	2,310	745	1,395	.421	.470
July	1,250	380	874	.263	.303
August	359	213	265	.080	.092
September	640	220	358	.108	.120
October	292	189	233	.070	.081
November	292	160	219	.066	.074

[a] April 15 to 17 discharge estimated.

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

This station was established October 26, 1902, by K. C. Kastberg, assisted by J. C. Stevens. It is located near the city gas works and near the plant of the Iowa Windmill and Pump Company. The gage is an inclined 4 by 6 inch timber, graduated to read to vertical tenths and half-tenths feet. It is fastened to the right bank by posts set in the ground. It is read twice each day by R. S. Toogood. Discharge measurements were made during 1903 from a cable and car at a point just above the gage. The points of measurement are marked by a tag wire. Discharge measurements have been made since 1903 at the First Avenue Bridge about one-half mile upstream from the gage. At low stages the discharge can be measured by wading at the cable. The initial point for soundings at the cable is the foot of the pole supporting the cable on the right bank of the river. The channel is straight for 800 feet above and below the cable. The right bank is high and will overflow only at extreme stages. The left bank is an earth embankment and will seldom overflow. The bed of the stream is rocky and permanent. At the cable the cross section is regular and the channel is about 400 feet wide. Bench mark No. 1 is a city bench mark at Williams & Huntings office, on the north corner of Fifth avenue and West First street. It is marked by a triangle on the stone just north of the first iron post from the corner of the building. Its elevation above sea level, as determined by the city of Cedar Rapids from levels of the Northwestern Railway, is 746.6 feet. Its elevation above the zero of the gage is 23.57 feet. Bench mark No. 2 is a bolt driven into the masonry foundation of the east face of the Iowa Windmill and Pump Company's building on the west bank of the river just north of Seventh avenue. Its elevation is 740.05 feet above sea level and 17.02 feet above the zero of the gage. At the First Avenue Bridge the channel has a rock and gravel bottom and a straight course, both above and below, for several hundred feet. It is divided into five parts by the 5-span Pratt truss bridge, its length from abutment to abutment being 714 feet. The current is strong and direct. The initial point for soundings is the inner upstream face of the left abutment, the measurements being taken from the upstream side of the bridge. The channel is straight for 500 feet above and 1,000 feet below. The banks are high and not liable to overflow. The bed is rock and gravel and permanent. The water flows in five channels. For the purpose of comparing soundings, the distance of the water surface below the top surface of the downstream hand rail at 1 foot west of the nineteenth hand-rail post from the left abutment is measured.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements[a] of Cedar River at Cedar Rapids, Iowa, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 14[b]	F. W. Hanna	542	893	1.06	3.60	948
March 15[b]	do	607	1,767	1.92	4.60	3,395
April 19	do	603	1,431	2.94	4.25	4,207
May 26	Johnson and Hanna	577	1,183	1.75	3.50	2,068
June 7	F. W. Hanna	616	1,718	2.62	4.35	4,510
July 11	do	574	1,267	1.84	3.65	2,336
August 17	do	544	893	1.16	3.00	1,040
September 7	do	571	948	1.03	3.13	1,239
October 22	do	497	674	1.57	3.00	1,056
November 12	do	529	811	1.08	2.90	875

[a] All measurements made from bridge. [b] Partially frozen.

Mean daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[b]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[c]
1	3.7	3.7	4.7	4.6	4.1	4.4	3.7	3.1	2.9	2.75	2.9	2.65
2	3.8	3.7	4.75	4.4	4.0	4.15	3.6	3.05	2.95	2.75	2.95	2.7
3	3.9	3.6	4.7	4.3	3.9	4.05	3.5	3.1	3.0	2.75	2.95	2.6
4	3.8	3.6	4.7	4.2	3.85	3.9	3.55	3.1	3.1	2.7	2.95	2.6
5	3.8	3.8	4.6	4.1	3.8	4.1	3.6	3.1	3.15	2.8	2.95	2.65
6	3.7	4.6	4.65	4.05	3.7	4.3	3.55	3.1	3.1	2.8	2.95	2.65
7	3.6	5.4	4.6	4.0	3.7	4.4	3.56	3.1	3.1	2.75	2.9	2.6
8	3.7	4.6	4.55	4.15	3.8	4.55	3.6	3.05	3.1	2.7	2.95	2.6
9	3.6	4.0	4.5	4.3	3.75	4.75	3.6	3.1	3.05	2.85	2.9	2.65
10	3.6	3.8	4.45	4.4	3.8	4.7	3.6	3.1	3.0	2.9	2.9	2.7
11	3.5	3.9	4.45	4.5	3.75	4.55	3.65	3.05	3.0	2.85	2.9	2.65
12	3.4	4.0	4.55	4.9	3.8	4.3	3.6	3.05	2.95	2.9	2.9	2.65
13	3.5	3.9	4.55	5.1	3.8	4.15	3.6	3.0	2.9	2.95	2.85	2.7
14	3.6	3.8	4.65	5.1	3.85	4.0	3.65	3.0	2.9	2.95	2.9	2.7
15	3.5	3.7	4.6	5.0	3.7	3.85	3.7	2.95	2.9	2.95	2.9	2.65
16	3.5	3.8	4.45	4.8	3.65	3.75	3.65	2.9	2.9	2.95	2.85	2.65
17	3.6	3.7	4.55	4.5	3.6	3.7	3.6	3.0	3.0	2.95	2.85	2.7
18	3.7	3.6	4.4	4.4	3.55	3.6	3.55	2.95	2.95	2.95	2.95	2.75
19	3.7	3.7	4.5	4.25	3.5	3.65	3.5	3.0	2.9	3.0	2.9	2.75
20	3.6	3.8	4.7	4.15	3.45	3.55	3.4	2.95	2.9	3.0	2.85	2.8
21	3.5	3.8	4.9	4.2	3.45	3.5	3.4	2.95	2.85	3.0	2.8	2.8
22	3.6	3.7	5.5	4.5	3.4	4.1	3.35	3.0	2.85	2.95	2.75	2.75
23	3.6	3.7	5.45	3.95	3.4	4.2	3.35	2.95	2.8	2.95	2.8	2.8
24	3.5	3.8	5.2	4.0	3.35	4.2	3.3	2.9	2.8	2.95	2.8	2.75
25	3.5	3.8	5.9	.....	3.3	4.0	3.25	2.9	2.85	3.0	2.8	2.75
26	3.6	3.7	6.4	4.5	3.55	3.9	3.4	2.85	2.9	3.0	2.75	2.75
27	3.6	3.8	6.1	4.5	4.4	3.85	3.2	2.9	2.85	3.0	2.7	2.8
28	3.7	3.7	5.65	4.4	4.98	3.75	3.15	2.85	2.85	3.0	2.7	.....
29	3.7	4.7	5.1	4.8	5.55	3.75	3.1	3.0	2.8	3.0	2.7	4.3
30	3.8	.....	4.9	4.2	5.1	3.70	3.15	2.95	2.75	3.0	2.65	.....
31	3.7	.....	4.75	.....	4.65	.....	3.1	2.95	.....	2.95	.....	3.6

[a] River frozen one-half to two-thirds across, January and February.
[b] River frozen during greater portion of month of March.
[c] River partially frozen December 2-27, inclusive, and wholly frozen December 28-31.

NOTE.—Gage heights are to water surface during frozen period.

Rating table for Cedar River at Cedar Rapids, Iowa, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.65	600	3.50	1,990	4.70	5,690	5.90	10,130
2.70	650	3.60	2,210	4.80	6,060	6.00	10,500
2.75	705	3.70	2,440	4.90	6,430	6.20	11,240
2.80	765	3.80	2,690	5.00	6,800	6.40	11,980
2.85	830	3.90	2,960	5.10	7,170	6.60	12,720
2.90	900	4.00	3,250	5.20	7,540	6.80	13,460
2.95	975	4.10	3,560	5.30	7,910	7.00	14,200
3.00	1,050	4.20	3,880	5.40	8,280	7.20	14,940
3.10	1,210	4.30	4,220	5.50	8,650	7.40	15,680
3.20	1,390	4.40	4,580	5.60	9,020	7.60	16,420
3.30	1,580	4.50	4,950	5.70	9,390	7.80	17,160
3.40	1,780	4.60	5,320	5.80	9,760	8.00	17,900

The above table is applicable only for open-channel conditions. It is based upon 22 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 3 feet and 7.20 feet. The table has been extended beyond these limits. Above gage height 4.4 feet the rating curve is a tangent, the difference being 370 per tenth.

Estimated monthly discharge of Cedar River at Cedar Rapids, Iowa, for 1904.

[Drainage area, 6,317 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	7,170	3,105	4,614	0.730	0.814
May	8,835	1,580	3,079	.487	.562
June	5,875	1,990	3,481	.551	.615
July	2,440	1,210	1,938	.307	.354
August	1,210	830	1,051	.166	.191
September	1,300	705	958	.152	.170
October	1,050	650	913	.145	.167
November	975	600	842	.133	.148

DES MOINES RIVER DRAINAGE BASIN.

Des Moines River rises in the southern part of Minnesota and flows south and southeast, entering the Mississippi near Keokuk, Iowa. Its principal tributary is Raccoon River, which enters the Des Moines at the city of Des Moines. Des Moines River is the largest river of Iowa, and affords numerous good opportunities for the development of water power. As it drains a large area, it is a natural recipient of the sewage of many towns. The United States Geological Survey maintained stations for a short time at Des Moines on Des Moines and Raccoon rivers. These were after a time discontinued and a permanent station was established at Keosauqua, Iowa. The total drainage area of Des Moines River is 14,720 square miles. Its drainage above the mouth of Raccoon River is 6,462 square miles, while that of the Raccoon at its confluence with the Des Moines is 3,677 square miles.

During 1904 stations were maintained in Des Moines River drainage basin on Des Moines River at Keosauqua, Iowa.

DES MOINES RIVER AT KEOSAUQUA, IOWA.

This station was established May 30, 1903, by F. W. Hanna. It is located at the county bridge one-fourth mile above the old dam site and Government locks. The standard chain gage has the zero of its scale 1 foot to the left of the sixth strut from the right end of the second span from the right end of the bridge. The length of the chain from the end of the weight to the marker is 36.80 feet. The gage is read twice each day by Oscar McCrary. Discharge measurements are made from the downstream side of the four-span bowstring truss bridge, to which the gage is attached. The initial point for soundings is marked zero on the hand rail at the left bank. This is the edge of the west abutment. The channel is straight for 1,000 feet above and below the station and has a width between abutments of 614 feet, broken by three piers. The right bank is high and rocky and is not subject to overflow; the low alluvial bank on the left side is subject to overflow at extremely high stages. The bed of the stream is regular in shape and is composed of sand and gravel on the left and of rock on the right side, and is divided into four channels by the bridge piers. A slight shifting of the sand occurs at flood stages. Bench mark No. 1 is a cross on the bridge-seat stone at the northeast corner of the right abutment of the bridge. Its elevation above gage datum is 30.11 feet, and above sea level is 617.06 feet, as determined from the Iowa Geological Survey bench mark in front of the Keosauqua railroad station. Bench mark No. 2 is located on a rock cliff on the right bank of the river south of the road leading across the highway bridge and at a distance of 120 feet from the east end of

the bridge. It consists of a notch chiseled into the ledge of rock. Its elevation above gage datum is 36.25 feet. Bench mark No. 3 is located on the top of the guard rail, 2 feet east of the zero of the gage. Its elevation is 36.60 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Des Moines River at Keosauqua, Iowa, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 13[a]	F. W Hanna	549	919	0.83	0.12	766
March 18	do	567	1,809	1.62	1.75	2,954
April 22	do	586	2,892	2.69	3.55	7,803
May 28	Johnson and Hanna.	586	2,632	2.65	3.14	6,979
June 9	F. W. Hanna	590	4,006	3.44	5.25	13,760
July 14	do	571	2,039	1.95	2.10	3,952
August 18	do	567	1,531	1.20	1.26	1,842
September 8	do	528	1,665	1.50	1.60	2,497
October 20	E. Johnson, jr	556	1,453	.66	.85	965
November 15	F. W. Hanna	556	1,270	.65	.79	825

[a] River frozen.

Mean daily gage height, in feet, of Des Moines River at Keosauqua, Iowa, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	.....	1.5	2.88	6.45	3.78	2.25	1.78	1.32	2.07	0.87	[b]0.90
2	1.2	2.1	.....	2.68	5.55	4.03	2.35	1.55	1.77	1.65	.87	1.45
3	.....	(c)	.....	2.63	4.90	3.73	2.30	1.48	1.67	1.32	.87	1.30
4	.....	.....	.....	2.43	4.40	4.58	2.12	1.52	1.72	1.14	.79	[b].82
5	[d]1.2	.....	[e]2.2	2.28	4.05	5.53	2.20	1.42	1.69	1.07	.77	.80
6	.....	[c]3.8	(c)	2.25	3.80	5.90	2.70	1.38	1.82	1.07	.74	.70
7	.....	[c]6.6	3.0	2.13	3.55	5.85	2.62	1.30	1.77	.99	.74	.70
8	.....	5.9	[f]2.46	2.38	3.60	5.70	2.75	1.25	1.62	.99	.74	.65
9	[g]1.15	5.9	2.96	6.88	3.55	5.20	2.58	1.20	1.45	.99	.74	.65
10	.....	.....	1.96	6.43	3.35	4.55	2.45	1.18	1.32	.95	.74	.60
11	.....	.....	1.56	5.73	3.15	4.15	2.40	1.13	1.28	.89	.69	.62
12	.....	[c]5.7	1.76	6.28	3.10	3.82	2.15	1.30	1.20	.89	.64	[h].75
13	[i]1.15	.....	1.56	6.28	3.20	3.50	2.08	1.70	1.63	.87	.64	.65
14	.....	.....	1.16	5.43	3.15	3.20	2.05	1.72	1.25	.87	.64	[j].60
15	.....	[e]2.7	1.56	5.38	3.20	2.95	2.00	1.55	1.10	.87	.74	.60
16	[i]1.15	.....	1.46	5.13	3.15	2.75	2.00	1.40	1.10	.82	.80	.60
17	.....	.....	1.46	4.93	3.15	2.45	1.95	1.32	1.02	.87	.75	.60

[a] Ice 1 foot thick.
[b] Frozen two-thirds of way across.
[c] Ice 0.8 foot thick.
[d] Ice 1.1 feet thick.
[e] Ice 0.9 foot thick.
[f] Ice broken up.
[g] Ice 1.25 feet thick.
[h] River frozen over.
[i] Ice 1.2 feet thick.
[j] Ice 3 inches thick.

Mean daily gage height, in feet, of Des Moines River at Keosauqua, Iowa, for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
18	.....	[a] 2.3	1.79	4.58	2.80	3.15	1.75	1.30	1.00	0.87	0.75	.....
19	.....	.....	3.60	4.33	2.65	2.70	1.65	1.35	1.50	.79	.75	.....
20	[b] 4.55	.....	3.45	4.08	2.50	2.25	2.35	1.50	1.35	.77	.75	.....
21	[c] 5.90	.....	2.80	3.73	2.40	2.30	6.70	1.42	1.20	.80	.70	.....
22	3.30	1.7	2.85	3.53	2.40	2.12	8.08	1.62	1.35	.80	.70	.....
23	2.40	.....	2.80	3.35	2.25	2.25	6.55	1.60	1.25	.83	.70	.....
24	2.00	.....	2.90	3.35	2.20	2.00	4.65	1.45	1.25	.88	.70	[d] 0.60
25	2.40	.....	7.35	[c] 10.95	2.10	2.38	3.28	1.42	1.15	1.00	.70	.....
26	[f] 3.1	.....	6.55	13.15	2.00	2.15	2.57	1.35	1.20	1.00	.70	.....
27	(g)	[a] 1.5	4.35	13.15	2.35	2.10	2.25	1.20	5.10	1.00	.70	.....
28	.....	[a] 1.5	3.95	12.45	3.30	2.23	2.05	1.15	6.60	.92	.70	.....
29	.....	1.5	3.38	12.15	4.00	2.50	1.85	1.18	3.15	.87	.70	.....
30	2.5	.....	2.95	9.90	4.30	2.40	1.70	1.15	2.45	.87	.72	.....
31	(h)	.....	2.95	.....	3.80	.....	2.22	1.20	.....	.84	.....	[i] .70

[a] Ice 0.9 foot thick.
[b] Ice 1.2 feet thick.
[c] Ice broken up.
[d] Ice thawed out.
[e] Heavy rain.
[f] River frozen over.
[g] Ice 0.4 foot thick.
[h] Ice 0.7 foot thick.
[i] Ice 4 inches thick.

NOTE.—Gage heights during frozen period to surface of water.

Rating table for Des Moines River at Keosauqua, Iowa, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	420	1.70	2,800	2.9	5,920	4.1	9,840
.60	590	1.80	3,030	3.0	6,220	4.2	10,200
.70	770	1.90	3,260	3.1	6,520	4.3	10,560
.80	950	2.00	3,500	3.2	6,830	4.4	10,930
.90	1,140	2.10	3,750	3.3	7,150	4.5	11,300
1.00	1,330	2.20	4,000	3.4	7,470	4.6	11,670
1.10	1,530	2.30	4,260	3.5	7,800	4.7	12,040
1.20	1,730	2.40	4,520	3.6	8,130	4.8	12,410
1.30	1,940	2.5	4,780	3.7	8,460	5.0	13,150
1.40	2,150	2.6	5,060	3.8	8,800		
1.50	2,360	2.7	5,340	3.9	9,140		
1.60	2,580	2.8	5,630	4.0	9,490		

The above table is applicable only for open-channel conditions. It is based upon 19 discharge measurements made during 1903 and 1904. It is well defined between gage heights 0.8 foot and 5.2 feet. There are two flood measurements above 5.2 feet gage height. The table has been extended beyond these limits. Above gage height 4.30 feet the rating curve is a tangent, the difference being 370 per tenth. Table same as for 1903 above 2.4 feet gage.

Estimated monthly discharge of Des Moines River at Keosauqua, Iowa, for 1904.

[Drainage area, 14,290 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 9–31	21,840	1,650	6,441	0.451	0.386
April	43,300	3,825	15,990	1.12	1.25
May	18,520	3,500	7,566	.529	.610
June	16,480	3,500	7,817	.547	.610
July	24,550	2,800	6,026	.422	.486
August	2,984	1,590	2,132	.149	.172
September	19,070	1,330	3,305	.231	.258
October	3,675	896	1,318	.092	.106
November	1,078	662	833	.058	.065

MISSOURI RIVER DRAINAGE BASIN.

Missouri River is formed by the junction of Jefferson, Madison, and Gallatin rivers at Three Forks, Mont. Of its tributaries, Osage River rises in the eastern part of Kansas, flows east, and enters the Missouri below Jefferson City, Mo. Big Sioux River drains the extreme eastern part of South Dakota and flows south into the Missouri at Sioux City, Iowa. Niobrara River drains the extreme northern part of Nebraska and flows east into the Missouri at Niobrara, Nebr. Yellowstone River has its source in a lake of the same name in Yellowstone National Park, from which it takes a general northeasterly course and flows into the Missouri near the Montana-North Dakota boundary. Its principal tributaries are Powder River, of which Clear Creek and Piney Creek, in Wyoming, are small tributaries near its headwaters, and the Bighorn, which drains northeastern Wyoming and of which the Shoshone is a tributary. Milk River rises on the divide in the northwestern part of Montana, flows northeast into Canada, and then, with a general easterly course, flows back into Montana, emptying into the Missouri in the northeastern part of the State. Musselshell River rises in Meagher County, in south-central Montana, flows east, then north into the Missouri, about 100 miles above the mouth of Milk River. Marias, Teton, and Sun rivers rise on the divide in the northwestern part of Montana and flow east into the Missouri. Two Medicine Creek is a tributary near its headwaters. West Gallatin River, the longest fork of the Gallatin, rises in Yellowstone Park and flows north to its junction at Three Forks, Mont., with Madison and Jefferson rivers. Middle Creek is a small tributary of East Gallatin River. Madison River

rises in Yellowstone Park and flows north parallel to the West Gallatin. Pryor Creek is a small tributary of the Yellowstone rising on the Crow Reservation, Mont. Jefferson River is formed by Beaverhead and Big Hole rivers. Its tributaries drain extreme southwestern Montana. Gasconade River rises in the Ozark Mountains in southern Missouri and flows northeasterly into Missouri River; it has excellent water-power facilities; its total drainage area is 3,466 square miles, and its drainage area at Arlington is 2,725 square miles.

MISSOURI RIVER NEAR TOWNSEND, MONT.

This station was established October 1, 1891, by the Missouri River Commission. The locality is 2,504 miles above the mouth of the river. A standard wire cable gage was erected on a county-road bridge located about 300 feet below the Northern Pacific Railway bridge across Missouri River near Townsend, Mont. Its zero is set at an approximate elevation of 3,700 feet above sea level, as determined from a primary line of levels run under the direction of the Commission in 1890 from Three Forks to Fort Benton, Mont., and starting from a bench mark of the Northern Pacific Railway at Gallatin, Mont. (See Annual Report of Chief of Engineers, 1891.)

The gage reads from 3,785 to 3,799 feet. A record of the daily gage height is maintained by the Department of Agriculture. The observer for both Departments is M. McMahon. A gage reading of 3,785 feet is taken as the zero of the United States Geological Survey observations. Discharge measurements are made from the lower side of the bridge, and distances are marked on the guard rail. The initial point for soundings is over the left pier on the lower side and is marked on the guard rail. The channel is straight for 300 feet above and below the station. The right bank is low, but has been known to be overflowed but once. The left bank is high and rocky. The bed of the stream is composed of clean gravel and is shifting. The channel is broken by three bridge piers, and the velocity is made uncertain by eddies and backwater. The piers are protected on the upstream side by heaps of riprap and by cofferdams. These cause an appreciable difference in the elevation of the water surface above and below these protections. They cause a contraction of the current, which has eroded large holes under the bridge.

The United States engineers' reference bench mark is B. M. 10 (Townsend), described as "located on the right bank of Missouri River, about one-half mile north of Townsend railroad station, about one-half mile from river, measured in a perpendicular direction to track, and about three-fourths mile south of the railroad bridge over Missouri River. It is about 60 feet west of a point on the track 30 feet north of railroad bridge No. 392, and about 7 feet west of railroad fence. Compass reading to milepost 1121 is 318°. Marked by

stone and pipe; elevation, 3,795.991 feet." This elevation is erroneous, but is the elevation from which the gage is set.

The tabulated records of the Townsend gage are reductions to the St. Louis directrix datum obtained by subtracting 400.063 feet from the daily means of the gage readings. In April, 1903, two new bench marks were established by J. S. Baker. The first has been destroyed. The second of these bench marks is a spike driven near the ground in the north side of a 12 by 12 inch post located on the north bank of the river about 200 feet below the bridge. Its elevation is 14.98 feet above the Geological Survey gage datum. A third bench mark was established April, 1904, by A. E. Place. It is marked by a chiseled cross on the southeast corner of the northeast bedplate of the north abutment of the railroad bridge, 300 feet west of the station. Its elevation is 24.614 above the zero of the gage. The area drained at this point is approximately 15,000 square miles, comprising, as above stated, the inflow from Gallatin, Madison, and Jefferson rivers. This gage at Townsend is the highest of a series of twenty or more gages maintained permanently by the Missouri River Commission. Descriptions of these gages are given in the annual report of the Missouri River Commission, contained in the Annual Report of the Chief of Engineers, United States Army; that for 1891, on page 3819; for 1892, on page 3271, and for 1893, on page 2316. The distance of this point above Sioux City is 1,703 miles, and above Fort Benton, the next gage below maintained by the Corps of Engineers, 219 miles. The station was abandoned May 31, 1904, on account of the obstructions and irregularities of the channel caused by the reconstruction of the Northern Pacific Railway bridge above the station. The gaging stations on Gallatin River at Logan, Mont., on Jefferson River at Sappington, Mont., and on Madison River at Norris, Mont., will cover all tributaries to the Missouri above the station with the exception of Sixteen Mile Creek, which enters at Lombard, Mont., and a few short creeks of minor importance. Between Townsend and Cascade, the next gaging station below, there is but one large tributary, Prickly Pear Creek. The headwaters of Missouri River can therefore be sufficiently measured without maintaining the Townsend station.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Missouri River near Townsend, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 15	A. E. Place	431	2,145	3.45	5.12	7,419
May 24	W. B. Freeman	404	3,475	6.45	7.89	22,405

Mean daily gage height, in feet, of Missouri River near Townsend, Mont., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.
1	6.10	5.60	6.00	4.20	6.40	17	5.60	5.60	4.10	5.10	6.30
2	6.10	5.60	6.30	4.10	6.20	18	5.60	5.60	4.10	5.00	6.30
3	6.10	5.60	6.40	4.20	6.10	19	5.60	5.70	4.10	5.00	6.40
4	6.10	5.60	6.50	4.30	6.30	20	5.60	5.70	4.10	5.20	6.60
5	6.10	5.60	6.60	4.50	6.50	21	5.60	5.70	4.20	5.40	6.90
6	6.10	5.60	6.80	4.50	6.60	22	5.70	5.70	4.10	5.60	7.10
7	6.10	5.60	6.90	4.40	6.30	23	5.60	5.70	4.10	5.70	7.40
8	6.10	5.60	7.00	4.30	6.30	24	5.60	5.70	4.00	5.60	7.90
9	6.10	5.60	7.00	4.30	6.20	25	5.60	5.70	3.60	5.70	8.40
10	5.60	5.60	7.00	4.40	5.90	26	5.60	5.70	3.70	5.90	8.40
11	5.60	5.60	7.00	4.50	5.90	27	5.60	5.70	3.90	5.70	8.10
12	5.60	5.60	7.00	4.90	6.00	28	5.60	5.80	4.10	5.90	7.90
13	5.60	5.60	7.00	4.90	6.10	29	5.60	5.90	4.20	6.20	7.50
14	5.60	5.60	7.00	5.00	5.90	30	5.60	.....	4.30	6.50	7.20
15	5.60	5.60	4.50	5.10	6.10	31	5.60	.....	4.30	.....	7.50
16	5.60	5.60	[a]4.20	5.10	6.20						

[a] Gage heights do not represent normal flow till March 16 on account of ice conditions. Station abandoned May 31.

Rating table for Missouri River near Townsend, Mont., from January 1, 1901, to May 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	1,200	4.20	4,270	5.40	8,555	7.20	17,040
3.10	1,390	4.30	4,600	5.50	8,965	7.40	18,210
3.20	1,590	4.40	4,930	5.60	9,375	7.60	19,450
3.30	1,800	4.50	5,260	5.70	9,795	7.80	20,760
3.40	2,020	4.60	5,600	5.80	10,220	8.00	22,150
3.50	2,250	4.70	5,940	5.90	10,655	8.20	23,650
3.60	2,490	4.80	6,285	6.00	11,100	8.40	25,410
3.70	2,745	4.90	6,635	6.20	12,015	8.60	27,490
3.80	3,020	5.00	7,000	6.40	12,960	8.80	29,830
3.90	3,315	5.10	7,375	6.60	13,930		
4.00	3,630	5.20	7,760	6.80	14,925		
4.10	3,950	5.30	8,155	7.00	15,950		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1901–1904. It is well defined between gage heights 3.3 feet and 8.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Missouri River near Townsend, Mont., for 1904.

[Drainage area, 14,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 2,700	166,016	0.186	0.214
February	.....	.....	[a] 2,700	155,306	.186	.201
March 15–31, inclusive	5,260	2,490	[b] 3,947	242,692	.272	.314
April	13,440	3,950	7,318	435,451	.505	.563
May	25,410	10,655	14,672	902,146	1.012	1.167

[a] Estimated by C. C. Babb. [b] Mean for 17 days taken as mean for entire month.

MISSOURI RIVER AT CASCADE, MONT.

This station was established July 20, 1902, by W. W. Schlecht. It is located at the highway bridge at the east end of the town of Cascade, Mont., about one-fourth mile from the railroad. There is an island about 600 feet above the station and one about 300 feet below. There is a fall of about 1 foot at the island below the station. The wire gage first installed has been replaced by a standard chain gage, which is located on the upstream side of the left span, and is fastened to the floor of the bridge. The distance from the end of the weight to the marker should be 31.97 feet. The marker is the outside of the ring which serves as a handle. The gage is read twice each day by H. W. Ludwig. Discharge measurements are made from the upstream side of the bridge. The central pier of this bridge is protected by an ice and drift breaker, which extends about 125 feet upstream. The initial point for soundings is notched on the guard rail 2.5 feet to the left of center of the southeast bridge pier. The channel is straight for about 600 feet above and 200 feet below the station. The right bank is low and the left bank is high, with bushes along both banks. The single channel is only broken by the bridge piers. The ice breaker affects the current to some extent. Two bench marks were established in April, 1904. Bench mark No. 1 is the top of an old iron bolt on the southwest iron bridge pier, which secures the bed plates. It is painted in black "U. S. G. S. B. M.," and has an elevation of 28.54 feet above the gage datum. Bench mark No. 2 is a standard bench mark of the Missouri River Commission, situated 200 feet east of the Great Northern Railway station. Its elevation above the gage zero is 36.58 feet.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Missouri River at Cascade, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 13	A. E. Place	373	3,060	2.19	5.52	6,714
May 28	L. R. Stockman	489	4,823	4.77	9.40	23,026
June 3	Murphy and Freeman.	466	4,767	4.29	9.24	20,437
June 11	W. B. Freeman	466	4,393	4.09	8.45	17,753
July 27	do	356	2,929	1.90	5.15	5,552
August 16	do	342	2,447	1.05	3.90	2,571
September 12	do	348	2,381	.95	3.80	2,255
November 10	L. R. Stockman		2,664	1.43	4.52	3,805

Mean daily gage height, in feet, of Missouri River at Cascade, Mont., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.20	5.50	6.15	5.80	7.35	8.42	6.70	4.40	3.80	3.95	4.45	4.45
2	5.30	5.50	6.20	5.80	7.25	8.62	6.55	4.40	3.75	3.95	4.40	4.45
3	5.30	5.50	6.20	5.50	7.18	9.05	6.38	4.40	3.70	4.00	4.40	4.50
4	5.45	5.50	6.20	5.30	7.10	9.20	6.30	4.40	3.65	4.00	4.35	4.53
5	5.50	5.60	6.25	5.30	7.12	9.20	6.12	4.40	3.60	4.00	4.35	4.55
6	5.50	5.60	6.25	5.25	7.28	9.08	5.98	4.40	3.55	4.00	4.33	4.60
7	5.40	5.70	6.25	5.15	7.38	8.92	5.88	4.40	3.55	4.00	4.35	4.50
8	5.40	5.70	6.20	5.05	7.30	8.80	5.80	4.40	3.60	4.00	4.40	4.40
9	5.40	5.70	6.20	5.00	7.28	8.70	5.80	4.45	3.65	4.02	4.40	4.30
10	5.50	5.70	6.20	5.10	7.18	8.70	5.85	4.45	3.70	4.05	4.40	4.20
11	5.50	5.80	6.10	5.20	7.05	8.55	5.92	4.40	3.80	4.10	4.40	4.10
12	5.50	5.60	6.10	5.30	6.90	8.50	5.88	4.40	3.80	4.12	4.40	4.10
13	5.50	5.80	6.10	5.50	6.90	8.45	5.80	4.40	3.80	4.18	4.40	4.20
14	5.50	5.80	6.10	5.90	6.90	8.28	5.75	4.25	3.80	4.20	4.40	4.20
15	5.50	5.90	6.00	6.00	6.90	8.10	5.72	4.05	3.80	4.25	4.40	4.25
16	5.50	5.90	6.00	6.15	6.90	7.98	5.70	3.95	3.80	4.25	4.40	4.25
17	5.50	5.90	6.00	6.05	6.90	7.88	5.62	4.00	3.80	4.25	4.40	4.30
18	5.50	6.00	6.00	5.95	6.95	7.78	5.52	4.00	3.80	4.30	4.40	4.30
19	5.50	6.00	6.00	6.00	7.10	7.88	5.42	4.00	3.80	4.30	4.40	4.35
20	5.40	6.10	5.90	5.98	7.25	8.00	5.52	4.00	3.80	4.30	4.50	4.50
21	5.40	6.10	5.90	6.08	7.48	8.08	5.50	4.00	3.80	4.30	4.50	4.55
22	5.40	6.20	5.90	6.25	8.00	7.95	5.55	4.00	3.75	4.30	4.50	4.70
23	5.40	6.20	5.80	6.48	8.30	7.75	5.50	4.00	3.75	4.30	4.50	4.70
24	5.40	6.20	5.80	6.52	8.60	7.62	5.42	4.00	3.75	4.35	4.50	4.80
25	5.40	6.10	5.80	6.50	8.88	7.52	5.32	4.00	3.75	4.35	4.50	[b]4.85
26	5.50	6.10	5.70	6.55	9.30	7.35	5.28	4.00	3.80	4.40	4.50	4.90
27	5.50	6.10	5.70	6.62	9.50	7.18	5.15	4.00	3.80	4.42	4.40	4.80
28	5.50	6.15	5.70	6.75	9.32	6.95	4.95	3.98	3.85	4.45	4.40	4.80
29	5.50	6.15	5.70	6.88	9.02	6.80	4.75	3.92	3.85	4.50	4.40	4.70
30	5.50	.....	5.70	7.08	8.62	6.72	4.55	3.90	3.90	4.50	4.45	4.70
31	5.50	.....	5.70	.....	8.38	.....	4.50	3.85	.....	4.50	.....	4.60

[a] River frozen January 1 to April 1. Readngs to top of ice. Ice 12 to 15 inches thick.
[b] River frozen December 26 to 31.

Rating table for Missouri River at Cascade, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	1,970	4.70	4,170	5.80	8,020	7.80	15,420
3.70	2,090	4.80	4,490	5.90	8,390	8.00	16,160
3.80	2,230	4.90	4,810	6.00	8,760	8.20	16,900
3.90	2,380	5.00	5,150	6.20	9,500	8.40	17,640
4.00	2,550	5.10	5,490	6.40	10,240	8.60	18,380
4.10	2,740	5.20	5,830	6.60	10,980	8.80	19,120
4.20	2,940	5.30	6,190	6.80	11,720	9.00	19,860
4.30	3,150	5.40	6,550	7.00	12,460	9.20	20,600
4.40	3,370	5.50	6,910	7.20	13,200	9.40	21,340
4.50	3,600	5.60	7,280	7.40	13,940		
4.60	3,870	5.70	7,650	7.60	14,680		

The above table is applicable only for open-channel conditions. It is based upon 16 discharge measurements made during 1902–1904. It is fairly well defined between gage heights 3.6 and 9.4 feet. Above gage height 5.5 feet the rating curve is a tangent, the difference being 370 per tenth.

Estimated monthly discharge of Missouri River at Cascade, Mont., for 1904.

[Drainage area, 18,295 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 6,000	368,926	0.328	0.378
February	.....	.....	[a] 6,000	345,124	.328	.354
March	.....	.....	[a] 6,000	368,926	.328	.378
April	12,830	5,150	8,409	500,370	.460	.513
May	21,710	12,090	14,925	917,702	.816	.941
June	20,600	11,350	16,660	991,339	.911	1.016
July	11,350	3,600	7,436	457,222	.406	.468
August	3,480	2,305	2,898	178,191	.158	.182
September	2,380	1,915	2,167	128,946	.118	.132
October	3,600	2,465	2,979	183,172	.163	.188
November	3,600	3,260	3,416	203,266	.187	.209
December	4,490	2,740	3,597	221,171	.197	.227
The year	.....	.....	6,707	4,864,355	.367	4.986

[a] Estimated.

MISSOURI RIVER AT MANNHAVEN, N. DAK.

This station was established October 25, 1904, by E. F. Chandler. It is located at Mannhaven, N. Dak., a town on the west side of Missouri River about 50 miles north of New Salem, on the Northern Pacific Railway, and 18 miles west of Underwood, on the Minneapolis, St. Paul and Sault Ste. Marie Railway. The gage, consisting of three sections made of 2 by 4 inch timbers, reading to tenths of feet, is installed on the right bank of the river behind the lumber office of John Netzer, the observer. Measurements are made by means of a small gasoline ferryboat which is rented for each measurement. The initial point for soundings is the face of the perpendicular bank under Lyon's elevator on the right side of the stream, and the distances for the soundings are obtained by means of stadia sights taken from the boat on the rods placed on each shore. The channel at low-water stages is about 1,450 feet wide and is straight for about 2 miles above and one-half mile below the station. The current has a medium velocity at ordinary stages. The right bank is a high cliff. The left bank is low, sandy, and wooded and is subject to overflow at high stages. The bed of the stream is sandy and shifting.

The observations at this station during 1904 were under the direction of E. Johnson, jr., district hydrographer.

Discharge measurement of Missouri River at Mannhaven, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
October 25.....	E. F. Chandler	800	4,840	2.95	3.11	14,270

Mean daily gage height, in feet, of Missouri River at Mannhaven, N. Dak., for 1904.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	.....	(a)	12	.....	(a)	23	.....	2.85
2	.....	.....	13	.....	2.90	24	.....	2.82
3	.....	[b]3.00	14	.....	2.90	25	.....	2.90
4	.....	.....	15	.....	2.85	26	3.10	2.95
5	.....	.....	16	.....	2.85	27	.....	.....
6	.....	.....	17	.....	2.80	28	3.12	.....
7	.....	.....	18	.....	2.75	29	3.21	.....
8	.....	[b]2.90	19	.....	2.70	30	3.15	.....
9	.....	.....	20	.....	2.75	31	3.08	.....
10	.....	.....	21	.....	2.75			
11	.....	.....	22	.....	2.80			

[a] Gage broken November 1 to 12, inclusive. [b] Estimated gage height.

MISSOURI RIVER NEAR BISMARCK, N. DAK.

This station was established September 28, 1904, by E. F. Chandler and is located near the town of Bismarck, N. Dak. The gage consists of a braided-wire affair of substantial pattern and is located near the middle of the second span of the Northern Pacific Railway bridge from the left bank. Measurements are made by the means of a cable ferry-boat at "Fort Lincoln" ferry, 5 miles southwest from Bismarck. The initial point for soundings is the face of the perpendicular bank on the right side of the river, and the distances from the initial point are obtained by stadia sights from the boat on rods placed on each shore. The channel is straight for nearly one-half mile both above and below the station. The current has a moderate velocity at ordinary stages. The right bank is high and not subject to overflow. The left bank consists of sandy slopes and wooded bottoms and is overflowed at extreme flood stages. The bed is sandy and subject to considerable shifting. The bench mark is the top of the railway track on the Northern Pacific Railway bridge at the gage and has an elevation of 73.9 feet above the datum of the gage. The gage is read each day by Mrs. Jennie S. Plante.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurement of Missouri River near Bismarck, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
October 28	E. F. Chandler	830	4,859	2.09	0.16	10,350

Mean daily gage height, in feet, of Missouri River near Bismarck, N. Dak., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.[a]	Day.	Sept.	Oct.	Nov.	Dec.[a]
1		0.10	0.20	0.60	17		0.40	0.55	2.05
2		.10	.10	.10	18		.40	.75	2.25
3		.10	.10	.00	19		.30	.90	2.55
4		.20	.10	.50	20		.30	1.00	2.60
5		.30	.10	.90	21		.30	1.00	2.70
6		.50	.10	.90	22		.40	1.00	2.85
7		.50	.10	.80	23		.40	.90	3.00
8		.50	.00	.45	24		.40	.80	3.30
9		.50	.00	.20	25		.20	.80	3.50
10		.50	.00	.10	26		.00	.80	3.50
11		.40	.00	.15	27		.00	.80	3.50
12		.50	.10	.40	28	0.05	.20	.60	3.85
13		.50	.10	.70	29	.10	.20	.18	4.10
14		.40	.10	1.20	30	.10	.20	.10	4.10
15		.40	.10	1.35	31		.20		3.90
16		.40	.15	1.70					

[a] River frozen during December.

MADISON RIVER (INCLUDING CHERRY CREEK) NEAR NORRIS, MONT.

This station is located at the ranch of the observer, Mrs. S. A. Black, 4 miles below the Redbluff County iron bridge over the Madison, and about 1½ miles below the mouth of Cherry Creek. It is also about 3 miles below the location of the old Redbluff station, described in Bulletin No. 131, on page 18. It was established May 2, 1897, at which time the one at Threeforks was discontinued. The vertical gage is fastened to a post set firmly in the bed of the river and braced with crosspieces from the bank. It is about 125 yards west of the observer's house. Discharge measurements are made from the lower side of the iron bridge above. Cherry Creek is measured at the same time, as it enters between the gage and the bridge. The initial point for soundings is at the left abutment of the bridge. The banks are high and do not overflow. The bed of the stream is rocky and the current is quite swift. The channel is curved both above and below the station, but the bridge is at right angles to the current. The bench mark established June 6, 1901, by J. S. Baker, is the top of a large granite bowlder 20 feet south of the gage rod and 8 feet east of the river bank. There is a spot of black paint on the top of the bowlder, and the letters "B. M. U. S. G. S. 6.856." The elevation of this bench mark is 6.856 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Madison River near Norris, Mont., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.	Discharge from Cherry Creek.[a]
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*	
April 19	A. E. Place	476	4.18	1.50	1,989	77
May 14	W. B. Freeman	557	4.28	1.91	2,384	80
June 14	do	854	6.51	2.87	5,558	130
July 6	do	623	5.04	2.10	3,140	73
July 19	do	493	4.43	1.78	2,186	20
August 23	W. B. Freeman and Robert Follansbee.	397	3.60	1.48	1,427	13
October 28	L. R. Stockman	404	3.61	1.45	1,459	12

[a] Add discharge of Cherry Creek to that of Madison to get entire amount passing gage.

Mean daily gage height, in feet, of Madison River near Norris, Mont., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	.....	.....	.....	1.40	1.70	3.00	2.30	1.60	1.48	1.40	1.40	1.40
2	.....	.....	.....	1.40	1.71	3.15	2.30	1.60	1.48	1.40	1.40	.....
3	.....	.....	.....	1.40	1.77	3.20	2.25	1.60	1.48	1.40	1.40	.....
4	.....	.....	.....	1.35	1.85	3.20	2.25	1.55	1.40	1.40	1.40	.....
5	.....	.....	.....	1.30	1.90	2.95	2.25	1.50	1.40	1.40	1.40	.....
6	.....	.....	1.40	1.30	1.99	2.95	2.20	1.50	1.40	1.40	1.40	.....
7	.....	.....	1.50	1.30	2.00	2.95	2.15	1.50	1.40	1.40	1.40	.....
8	.....	.....	1.60	1.30	1.90	2.95	2.10	1.50	1.40	1.40	1.40	.....
9	.....	.....	1.50	1.30	1.85	3.00	2.00	1.50	1.40	1.40	1.40	.....
10	.....	.....	1.40	1.45	1.87	3.00	2.00	1.50	1.40	1.40	1.40	.....
11	.....	.....	1.40	1.45	1.90	3.02	2.00	1.50	1.40	1.40	1.40	.....
12	.....	.....	1.40	1.45	1.90	3.00	2.05	1.50	1.40	1.40	1.40	.....
13	.....	.....	1.40	1.45	1.90	2.90	2.00	1.50	1.40	1.40	1.40	.....
14	.....	.....	1.40	1.45	1.90	2.85	1.90	1.50	1.40	1.40	1.40	.....
15	.....	.....	1.40	1.40	2.00	2.80	1.90	1.50	1.40	1.40	1.40	.....
16	.....	.....	1.40	1.40	2.00	2.80	1.85	1.50	1.40	1.40	1.40	.....
17	.....	.....	1.40	1.45	2.05	2.80	1.85	1.50	1.40	1.45	1.40	.....
18	.....	.....	1.40	1.50	2.10	2.90	1.80	1.50	1.40	1.45	1.40	.....
19	.....	.....	1.40	1.55	2.22	3.10	1.80	1.50	1.40	1.45	1.40	.....
20	.....	.....	1.30	1.55	2.35	2.95	1.75	1.50	1.40	1.45	1.40	.....
21	.....	.....	1.30	1.52	2.50	2.85	1.75	1.50	1.42	1.45	1.40	.....
22	.....	.....	1.30	1.50	2.70	2.85	1.75	1.50	1.45	1.45	1.40	.....
23	.....	.....	.....	1.50	2.90	2.90	1.75	1.50	1.45	1.45	1.40	.....
24	.....	.....	.....	1.50	3.15	2.76	1.75	1.50	1.45	1.45	1.40	.....
25	.....	.....	.....	1.50	3.20	2.70	1.72	1.45	1.45	1.45	1.40	.....
26	.....	.....	1.40	1.50	3.05	2.60	1.70	1.45	1.45	1.45	1.40	.....
27	.....	.....	1.40	1.55	2.85	2.45	1.70	1.45	1.45	1.45	1.40	.....
28	.....	.....	1.40	1.60	2.70	2.30	1.70	1.45	1.45	1.45	1.40	.....
29	.....	.....	1.40	1.70	2.70	2.30	1.71	1.48	1.45	1.45	1.40	.....
30	.....	.....	1.40	1.70	2.70	2.30	1.72	1.48	1.45	1.40	1.40	.....
31	.....	.....	1.40	.....	2.90	.....	1.60	1.48	.....	1.40	.....	.....

[a] River frozen January 1 to March 5, March 23–25, and December 2–31, inclusive.

Rating table for Madison River (including Cherry Creek) near Norris, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	1,100	1.80	2,285	2.30	3,855	2.80	5,455
1.35	1,200	1.85	2,430	2.35	4,015	2.85	5,615
1.40	1,300	1.90	2,580	2.40	4,175	2.90	5,775
1.45	1,410	1.95	2,735	2.45	4,335	2.95	5,935
1.50	1,520	2.00	2,895	2.50	4,495	3.00	6,095
1.55	1,635	2.05	3,055	2.55	4,655	3.05	6,255
1.60	1,755	2.10	3,215	2.60	4,815	3.10	6,415
1.65	1,880	2.15	3,375	2.65	4,975	3.15	6,575
1.70	2,010	2.20	3,535	2.70	5,135	3.20	6,735
1.75	2,145	2.25	3,695	2.75	5,295		

The preceding table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly well defined between gage heights 1.50 feet and 2.87 feet. The table has been extended beyond these limits. Above gage height 2.0 feet the rating curve is a tangent, the difference being 320 per tenth.

Estimated monthly discharge of Madison River (including Cherry Creek) near Norris, Mont., for 1904.

[Drainage area, 2,085 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 1,200	73,785	0.576	0.664
February	.....	.....	[a] 1,200	69,025	.576	.621
March [b]	1,755	1,100	[c] 1,288	79,196	.618	.712
April	2,010	1,100	1,433	85,269	.687	.766
May	6,735	2,010	3,745	230,271	1.796	2.071
June	6,735	3,855	5,610	333,818	2.691	3.002
July	3,855	1,755	2,667	163,988	1.279	1.475
August	1,755	1,410	1,532	94,199	.735	.847
September	1,520	1,300	1,355	80,628	.650	.725
October	1,410	1,300	1,346	82,762	.646	.745
November	1,300	1,300	1,300	77,355	.624	.696
December	.....	.....	[a] 1,200	73,785	.576	.664
The year	.....	.....	1,990	1,444,081	.954	12.988

[a] Estimated by C. C. Babb.
[b] March 6-31, inclusive. March 23, 24, 25 estimated.
[c] Mean for 26 days taken as mean for month.

WEST GALLATIN RIVER NEAR SALESVILLE, MONT.

The Salesville station, which has been maintained for a number of years, was established near Williams's ranch, about 16 miles southwest of Bozeman. A gage rod was erected in July, 1895, and observations were begun on August 1 by Ira T. Williams, a ranchman, living about 600 feet away. The gage was spiked to a tree. The bench mark consisted of a 6-inch spike driven in the top of a stump 5 feet north of the gage post. It was 6.71 feet above the zero of the gage, as lowered 5 feet from the original position. A second bench mark consisted of a 6-inch spike driven into the east bridge abutment. This was 9.26 feet above the zero of the gage. The initial point for soundings is marked on the guard rail over the rim of the left pier. The highway bridge, from the lower side of which discharge measurements are made, is not at right angles to the current. At flood stages the water flows behind the bridge abutments on the right bank, but at

other times is confined within the channel. The bed of the stream is composed of bowlders and is not liable to change. The velocity is high, rendering discharge measurements somewhat difficult. The channel is nearly straight, with slight curves both above and below. The West Gallatin canal, carrying about 125 second-feet between July 1 and September 15, is taken out below the station. The Kleinschmidt canal, carrying about 50 second-feet between July 1 and August 15, and one or two smaller ditches are taken out above the station. In September, 1896, a wire gage was placed on the bridge, the pulley being fastened to the end of the rod opposite the 0.15-foot mark. The distance from the end of the weight to the index marker is 15.50 feet. On October 15, 1903, this length was 15.70 feet. The two gages were made to read the same. April 20, 1904, a standard chain gage was substituted for the wire gage, maintaining the same datum above the zero of the gage. The new chain length was made 17.38 feet from end of weight to marker, the latter being a wire index near handle. During high water, however, the old rod gage is read, as it stands in less turbulent water. Bench mark No. 1 for the new gage is the head of the most westerly rivet holding the angle irons to the pier of the southeast cylindrical pier. Its elevation is 13.865 feet above the gage datum. Bench mark No. 2, established May 22, 1900, by J. S. Baker, is a large bowlder set firmly in the ground on the south side of the wagon road, near the fence. It is 123 feet east of the center of the southeast cylindrical pier, and is at an elevation of 13.69 feet above the gage datum. The observers were Miss Marguerite Williams and Mrs. Alvin De Long.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of West Gallatin River at Salesville, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 13	W. B. Freeman	98	311	4.10	4.21	1,275
May 31	W. B. Freeman and E. C. Murphy.	143	587	7.68	6.33	4,510
June 13	W. B. Freeman	143	561	7.37	6.16	4,132
July 5	do	136	448	5.79	5.18	2,595
July 18	do	98	325	4.22	4.23	1,371
August 22	W. B. Freeman and Robert Follansbee.	91	221	2.45	3.34	542
October 27	L. R. Stockman	87	221	2.22	3.17	491

Mean daily gage height, in feet, of West Gallatin River at Salesville, Mont., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	2.90	2.60	2.70	4.20	6.75	5.70	3.85	3.25	3.30	3.10	2.90
2	2.80	2.70	2.70	2.80	4.00	6.65	5.50	3.75	.....	3.30	3.10	2.90
3	2.80	[a]2.80	2.60	2.80	4.20	6.45	5.60	3.75	3.25	3.30	3.10	3.00
4	2.90	3.00	2.80	2.90	4.20	6.10	.....	3.75	3.25	3.20	3.00	2.90
5	2.90	3.10	2.70	2.90	4.40	6.00	5.20	3.75	3.25	3.20	3.00	2.90
6	2.90	2.80	2.70	2.80	4.20	6.75	5.20	3.65	3.25	3.20	3.10	2.90
7	2.90	2.70	2.70	2.80	4.20	6.55	5.30	3.55	3.25	3.20	3.10	2.90
8	2.90	2.70	2.80	2.80	4.20	6.15	5.30	3.55	3.15	3.20	3.10	2.90
9	2.90	2.70	2.80	2.80	4.20	6.45	5.20	3.45	3.15	3.20	3.10	2.90
10	[a]2.90	2.80	2.80	2.90	4.30	6.85	5.20	3.55	3.15	3.20	3.10	2.90
11	3.10	2.70	2.80	4.10	4.30	6.75	5.10	3.65	3.15	3.30	3.10	2.90
12	3.10	2.80	2.70	3.40	4.30	6.30	4.80	3.65	3.15	3.30	.....	2.90
13	3.10	2.80	2.70	3.20	4.20	6.15	4.90	3.65	3.25	3.30	3.10	2.90
14	3.05	2.70	2.60	3.00	4.40	6.25	4.90	3.65	3.25	3.30	3.10	2.90
15	3.05	2.70	2.60	3.00	4.60	6.50	4.70	3.55	3.25	3.30	3.10	2.90
16	2.80	2.70	2.70	3.20	4.60	6.55	4.70	3.55	3.15	3.30	3.10	2.90
17	2.80	2.70	2.70	3.20	4.80	6.80	4.50	3.45	3.25	3.20	3.00	2.90
18	2.80	2.70	2.80	3.20	5.30	7.00	4.25	3.45	3.15	3.20	3.00	2.90
19	2.70	2.70	2.70	3.40	5.40	7.15	4.30	3.35	3.15	3.20	3.00	2.90
20	2.70	2.70	2.70	3.80	5.60	6.60	4.30	3.35	3.25	3.20	3.00	2.90
21	2.70	2.70	2.70	3.80	5.80	6.65	4.30	3.35	3.35	3.20	3.00	2.90
22	2.70	2.80	2.70	3.60	6.30	6.35	4.20	3.35	3.35	3.20	3.00	2.80
23	2.70	2.80	2.70	3.40	6.90	6.05	4.30	3.35	3.35	3.20	3.00	2.80
24	2.70	2.80	2.60	3.40	7.20	5.75	4.20	3.25	3.35	3.20	3.10	2.80
25	2.80	2.80	2.60	3.60	6.20	5.65	4.20	3.25	3.35	3.10	3.10	2.80
26	2.80	2.80	2.70	3.80	5.70	5.35	4.20	3.25	3.35	3.10	3.10	2.70
27	2.80	2.80	2.70	4.00	5.30	5.45	4.20	3.15	3.35	3.15	3.10	2.70
28	2.80	2.80	2.70	4.20	5.40	5.50	4.20	3.35	3.35	3.20	3.00	2.80
29	2.90	2.80	2.70	4.00	6.10	5.45	4.10	3.45	3.35	3.10	3.00	2.90
30	2.90	.....	2.70	4.00	5.70	5.55	4.00	3.45	3.35	3.10	3.00	3.00
31	2.90	.....	2.70	.....	6.30	.....	3.90	3.35	.....	3.10	.....	3.00

[a] Ice formed on edges January 10 and February 3, making channel very narrow.

Rating table for West Gallatin River at Salesville, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	320	3.60	710	4.60	1,875	5.60	3,375
2.70	335	3.70	785	4.70	2,025	5.70	3,525
2.80	355	3.80	875	4.80	2,175	5.80	3,675
2.90	375	3.90	965	4.90	2,325	5.90	3,825
3.00	400	4.00	1,065	5.00	2,475	6.00	3,975
3.10	435	4.10	1,180	5.10	2,625	6.20	4,275
3.20	475	4.20	1,310	5.20	2,775	6.40	4,575
3.30	525	4.30	1,450	5.30	2,925	6.60	4,875
3.40	585	4.40	1,590	5.40	3,075	6.80	5,175
3.50	645	4.50	1,730	5.50	3,225	7.00	5,475

The preceding table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly well defined between gage heights 3.1 feet and 6.4 feet. The table has been extended beyond these limits. Above gage height 5.0 feet the rating curve is a tangent, the difference being 150 per tenth.

Estimated monthly discharge of West Gallatin River at Salesville, Mont., for 1904.

[Drainage area, 860 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	435	335	369	22,689	0.429	0.495
February	435	335	351	20,190	.408	.440
March	355	320	336	20,660	.391	.451
April	1,310	335	612	36,416	.712	.794
May	5,775	1,065	2,563	157,593	2.980	3.436
June	5,700	3,000	4,400	261,818	5.116	5.708
July	3,525	965	2,053	126,234	2.387	2.752
August	920	455	653	40,151	.759	.875
September	555	455	506	30,109	.588	.656
October	525	435	482	29,637	.560	.646
November	435	400	421	25,051	.490	.547
December	400	335	372	22,873	.432	.498
The year	5,775	320	1,093	793,421	1.271	17.298

GALLATIN RIVER AT LOGAN, MONT.

This station was established August 24, 1893, by F. H. Newell, at the railroad pump house immediately below the Northern Pacific Railway bridge crossing Gallatin River at Logan, Mont. The gage was a vertical rod fastened to the cribwork box sunk in the river for the protection of the inlet pipe of the pump. The bench marks consisted of nails driven into the angle of the pier of the bridge facing the gage, these being placed at the elevation of the 7, 8, 9, and 10 foot marks, and designated by corresponding figures. At the bridge itself measurements of volume can not well be made, as the stream is divided into four channels, being very swift in two of these and obstructed by piles, snags, and sand in the others. Above the bridge, however, is a broad straight course, where measurements can be made by means of a boat and cable.

On March 10, 1894, the gage rod was washed out, together with the crib to which it was attached, no discharge measurements having been made while it was in place.

On November 16, 1894, a new gage was established by Arthur P. Davis, under the northeast corner of the Northern Pacific Railway bridge above mentioned. This gage consisted of timbers partly inclined and partly vertical, the lower inclined portion being graduated from 0.6 foot up to 7.1 feet and the vertical portion from 7 feet up to 12.1 feet. Bench mark No. 1 was on the head of a bridge spike in the top of the pile stump to which the lower end of the inclined gage was fastened. Its elevation was 1.62 feet above the zero of the gage. Bench mark No. 2 was the head of a bridge spike driven horizontally into the first pier east of the river. It was driven into the north end and was marked "B. M." Its elevation was 9.32 feet above the zero of the gage. The measurements were made by means of a cable across the river 100 yards above the bridge.

On September 16, 1896, a wire gage was placed in the east span of the railroad bridge and fastened to the guard rail on the upper side. The distance from the outside edge of the pulley to the end of the rod was 1 foot; from the end of the weight to the index marker was 18.4 feet. Bench mark No. 1 was the top of the northeast corner of the iron plate at the foot of the diagonal end member of the truss at the east end on the upper side, and was 13.7 feet above datum. Bench mark No. 2 was a spike in a pile stump, described and called "Bench mark No. 1" in the description of the 1894 gage.

The present station is located 450 feet northeast of the railroad bridge and 600 feet northwest of the railroad station. It was established in October, 1901, by J. S. Baker. The standard chain gage is placed on a horizontal frame 20 feet east of the south cable support. The chain length from end of weight to the outside of handle ring is 21.21 feet. The gage is read once each day by N. A. Smith. Discharge measurements are made by means of a cable, car, stay wire, and tagged wire about 450 feet above the railroad bridge. The initial point for soundings is the left cable support. The channel is straight for 200 feet above and below the station. The current has a moderate velocity. The right bank is high and rocky and is not liable to overflow. The left bank is low, but will overflow only at extremely high stages. Both banks are covered with bushes. The bed of the stream is sandy, with a small amount of vegetation. On July 27, 1901, the datum of the gage was raised 1.23 feet. The bench marks in present use are located as follows: Bench mark No. 1 is a railroad spike in the west side of the post of the gage frame, 3.6 feet from the top of the bridge bar. Its elevation is 8 feet above gage zero. Bench mark No. 2 is a temporary bench mark; it is a point halfway down on the bevel edge at the top of the coping of the northeast abutment of the Northern Pacific Railway bridge. Its elevation is 11.705 feet above gage zero.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Gallatin River at Logan, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 16	A. E. Place	150	556	2.51	2.34	1,399
April 24	do	150	563	2.61	2.45	1,467
May 24	W. B. Freeman	150	945	5.59	4.98	5,280
May 30	W. B. Freeman and E. C. Murphy.	151	782	4.26	4.08	3,330
June 18	W. B. Freeman	152	885	4.99	4.71	4,418
June 27	do	148	678	3.36	3.30	2,278
July 20	do	141	447	1.96	1.83	878
August 20	do	137	294	1.00	.78	294

Mean daily gage height, in feet, of Gallatin River at Logan, Mont., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	1.30	1.00	1.10	2.85	(b)	3.15	1.40	1.20	1.55	1.60	1.55
2	1.50	1.10	1.00	1.20	2.85	4.85	3.20	1.35	1.20	1.55	1.60	1.50
3	a1.80	1.00	1.00	1.30	2.90	4.80	3.30	1.20	1.20	1.60	1.60	1.50
4	a2.10	1.00	1.00	1.60	3.00	4.60	(b)	1.20	1.10	1.60	1.60	1.45
5	a2.80	1.10	1.00	1.90	3.00	4.50	3.20	1.15	1.10	1.60	1.60	1.45
6	a3.10	1.10	1.40	1.90	3.00	4.50	3.05	1.05	1.20	1.60	1.60	1.50
7	a3.60	1.10	1.50	1.70	3.10	4.60	2.80	1.05	1.20	1.60	1.60	1.50
8	a3.80	1.10	1.80	1.50	3.00	4.70	2.70	1.00	1.20	1.60	1.60	1.50
9	a2.90	1.30	1.40	1.60	2.80	4.60	2.60	1.00	1.20	1.60	1.60	1.50
10	1.50	1.40	1.20	1.90	2.90	(b)	2.50	.90	1.20	1.60	1.60	1.50
11	1.10	1.40	1.10	2.50	3.00	4.90	2.40	.85	1.20	1.60	1.60	1.60
12	1.00	1.50	1.10	2.50	3.00	4.95	2.30	.80	1.20	1.60	1.60	1.70
13	1.00	1.60	1.20	2.50	2.95	4.80	2.35	.75	1.20	1.60	1.60	1.80
14	1.00	1.60	1.20	2.30	2.95	4.60	2.35	.70	1.20	1.60	1.60	1.80
15	1.00	1.60	1.20	2.60	2.95	4.50	2.30	.60	1.20	1.60	1.60	1.85
16	1.00	1.50	1.20	2.30	3.15	4.50	2.15	.60	1.20	1.60	1.60	1.90
17	1.00	1.40	1.20	2.30	3.20	4.80	2.10	.60	1.20	1.60	1.60	1.85
18	1.00	1.40	1.20	2.00	3.40	4.75	2.10	.70	1.30	1.60	1.60	1.85
19	1.00	1.40	1.20	2.00	3.90	4.90	2.00	.70	1.40	1.60	1.60	1.85
20	1.00	1.40	1.20	2.10	(b)	4.65	1.80	.70	1.40	1.60	1.60	1.85
21	1.20	1.50	1.20	2.30	4.05	4.40	1.75	.60	1.40	1.60	1.60	1.85
22	1.30	1.30	1.20	2.30	4.60	4.30	1.70	.70	1.40	1.60	1.60	1.85
23	1.10	1.00	1.20	2.30	4.85	4.10	1.65	.80	1.40	1.60	1.60	1.85
24	1.15	.80	1.10	2.20	5.15	3.90	1.60	.85	1.40	1.60	1.60	1.85
25	1.20	1.00	1.00	2.20	5.00	3.80	1.60	.95	1.40	1.60	1.60	1.85
26	1.30	1.00	1.00	2.25	4.30	(b)	1.65	1.00	1.40	1.60	1.60	1.85
27	1.30	1.20	1.00	2.50	4.10	3.30	1.60	1.00	1.45	1.60	1.60	1.85
28	1.40	1.10	1.00	2.85	4.05	3.25	1.60	1.05	1.55	1.60	1.60	a4.10
29	1.20	1.00	1.20	3.00	4.10	3.25	1.60	1.10	1.55	1.60	1.60	a4.00
30	1.30	.....	1.20	2.85	4.30	3.20	1.60	1.00	1.60	1.60	1.60	a3.00
31	1.50	.....	1.20	.....	4.30	.....	1.50	1.10	.....	1.60	.....	a3.00

a Ice jam at railroad bridge (100 yards below station) from January 8 to 9 and December 28 to 31.
b No observation.

Rating table for Gallatin River at Logan, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	210	1.60	740	2.70	1,670	3.80	2,950
.60	230	1.70	810	2.80	1,770	3.90	3,090
.70	260	1.80	880	2.90	1,870	4.00	3,240
.80	300	1.90	955	3.00	1,980	4.20	3,540
.90	340	2.00	1,035	3.10	2,090	4.40	3,870
1.00	385	2.10	1,120	3.20	2,205	4.60	4,230
1.10	435	2.20	1,210	3.30	2,325	4.80	4,620
1.20	485	2.30	1,300	3.40	2,445	5.00	5,050
1.30	545	2.40	1,390	3.50	2,565		
1.40	605	2.50	1,480	3.60	2,685		
1.50	670	2.60	1,570	3.70	2,815		

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined between gage heights 0.8 foot and 5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Gallatin River at Logan, Mont., for 1904.

[Drainage area, 1,805 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 11–31	670	385	[a]462	28,407	0.256	0.295
February	740	300	524	30,141	.293	.316
March	880	385	478	29,391	.265	.306
April	1,980	435	1,169	69,560	.648	.723
May	5,400	1,770	2,772	170,444	1.536	1.771
June	4,940	2,205	3,897	231,888	2.159	2.409
July	2,325	670	1,290	79,319	.715	.824
August	605	230	357	21,951	.198	.228
September	740	435	544	32,370	.301	.336
October	740	705	738	45,378	.409	.472
November	740	740	740	44,033	.410	.457
December [b]	955	635	825	50,727	.457	.527
The year	5,400	230	1,150	833,609	0.637	8.664

[a] Mean of January 11 to 31 is taken as mean for month.
[b] Discharge December 28 to 31 estimated 915 second-feet.

JEFFERSON RIVER NEAR SAPPINGTON, MONT.

This station was established November 13, 1894, by A. P. Davis. It is located 300 feet above the railroad bridge, 1 mile north of the

railroad station at Sappington, and 7 miles above Willow Creek. The chain gage is fastened to the guard rail on the upstream side of the south span of the old Northern Pacific Railway bridge. The length of the chain from the end of the weight to the marker is 16.30 feet. It is read twice each day by John Fraser. Discharge measurements were made by means of a cable, car, and tagged wire about 300 feet above the bridge to which the gage is attached. November 1 a new cable was installed some 500 feet above the old one on account of a new railroad bridge being built at the former site. The section at this place is an excellent one, the channel being straight for 500 feet above and below, the bed smooth and regular, covered with gravel, and entirely free from eddies. The current velocity is swift. Both banks are composed of clay and are covered with willows and underbrush. The right bank may overflow at extreme high water. On November 3, 1897, the gage datum was lowered 0.8 foot. The subsequent years were adjusted to the new datum, but the remainder of 1897 was corrected to agree with the old datum. Bench mark No. 1 consists of a 6-inch wire nail driven vertically in the east side of the blocking which forms the south abutment of the railroad bridge and is 12.90 feet above gage datum. Bench mark No. 2 is a 6-inch wire nail in a telegraph pole about 30 feet south and east of the south abutment of the bridge and is at an elevation of 9.93 feet above gage datum. Bench mark No. 3 is the head of the northwest bolt fastening the switch standard to the cross-tie 30 feet east of the bridge; its elevation is 17.70 feet above gage datum. Bench mark No. 4 is cross on top of coping at NW. corner of small culvert 800 feet from bridge. Elevation 11.568 feet above gage datum.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Jefferson River near Sappington, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	A. E. Place	270	1,248	4.10	4.40	5,126
May 18	W. B. Freeman	268	1,360	4.21	4.90	5,727
May 30	W. B. Freeman and E. C. Murphy.	268	1,457	4.77	5.43	6,949
June 28[a]	W. B. Freeman	250	1,041	3.39	3.65	3,533
July 23[a]	do	227	762	1.78	2.39	1,358
August 24[a]	W. B. Freeman and Robert Follansbee.	220	358	1.24	1.45	445
November 1[b]	L. R. Stockman	260	574	1.80	2.00	1,032

[a] From bridge below cable. [b] From a new section 300 feet above old cable section.

Mean daily gage height, in feet, of Jefferson River near Sappington, Mont., for 1904.[a]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.05	4.10	4.10	2.40	5.00	5.45	3.15	2.05	1.65	1.55	2.00	2.50
2	4.10	4.10	4.10	2.40	4.80	5.50	3.10	1.95	1.65	1.55	2.00	2.45
3	4.10	4.10	4.10	2.40	4.75	5.80	3.05	1.95	1.65	1.55	2.00	2.30
4	4.25	4.10	4.15	2.40	5.15	5.85	3.05	1.95	1.65	1.55	2.05	2.30
5	4.30	4.10	4.20	2.40	5.50	5.60	3.15	1.85	1.65	1.55	2.10	2.30
6	4.30	4.10	4.30	2.40	5.35	5.45	3.40	1.80	1.65	1.65	2.10	2.20
7	4.30	4.10	4.55	2.40	4.90	5.45	3.60	1.70	1.65	1.65	2.20	2.20
8	4.30	3.85	4.30	2.40	4.85	5.30	3.30	1.60	1.60	1.65	2.20	2.20
9	4.20	3.80	3.45	2.40	4.75	5.25	3.25	1.45	1.55	1.65	2.20	2.20
10	4.30	3.80	2.70	2.40	4.50	5.15	3.15	1.60	1.55	1.65	2.20	2.20
11	4.35	3.70	2.50	2.50	4.45	5.10	3.15	1.65	1.55	1.65	2.20	2.20
12	4.40	3.75	2.40	2.65	4.55	4.95	3.15	1.60	1.55	1.65	2.20	2.10
13	4.40	3.80	2.40	2.90	4.55	4.70	3.15	1.50	1.55	1.80	2.20	2.15
14	4.50	3.80	2.40	3.00	4.55	4.50	3.15	1.55	1.55	1.75	2.20	2.30
15	4.50	3.80	2.40	3.25	4.60	4.35	3.15	1.55	1.55	1.85	2.20	2.30
16	4.50	4.05	2.40	3.35	4.90	4.35	3.05	1.55	1.55	1.90	2.20	2.25
17	4.50	4.20	2.40	3.30	4.95	4.35	2.85	1.55	1.55	1.95	2.20	2.20
18	4.50	4.20	2.40	3.30	4.90	4.35	2.60	1.55	1.55	1.95	2.20	2.30
19	4.40	4.20	2.30	3.30	5.00	4.35	2.50	1.55	1.55	1.95	2.35	2.30
20	4.15	4.20	2.30	3.55	5.15	4.45	2.45	1.55	1.55	1.95	2.50	2.20
21	3.75	4.20	2.30	4.10	5.30	4.40	2.45	1.55	1.55	2.05	2.50	2.20
22	3.90	4.20	2.30	4.20	5.50	4.20	2.45	1.50	1.55	2.15	2.45	2.20
23	3.90	4.20	2.30	4.35	5.65	4.10	2.35	1.45	1.55	2.15	2.40	2.20
24	3.90	4.20	2.40	4.40	6.35	4.15	2.35	1.45	1.55	2.05	2.45	2.20
25	3.90	4.10	2.35	4.50	6.45	4.15	2.35	1.45	1.55	2.05	2.50	2.20
26	3.90	4.15	2.25	4.55	6.65	4.00	2.25	1.45	1.55	2.05	2.50	2.60
27	3.95	4.20	2.20	5.00	6.45	3.90	2.25	1.45	1.55	2.05	2.50	3.30
28	4.00	4.20	2.35	5.50	5.85	3.70	2.20	1.45	1.55	2.05	2.50	3.50
29	4.00	4.10	2.40	5.55	5.55	3.40	2.15	1.50	1.55	2.00	2.50	6.40
30	4.05	.....	2.50	5.45	5.45	3.25	2.10	1.55	1.55	1.95	2.50	6.90
31	4.10	.....	2.50	.....	5.35	.....	2.05	1.60	.....	1.95	.....	7.00

[a] Readings from January 1 to March 9, 1904, inclusive, and from December 27–31, 1904, inclusive, do not represent the flow due to ice gorging.

Rating table for Jefferson River near Sappington, Mont., from March 10 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	505	2.60	1,720	3.70	3,635	4.80	5,725
1.60	585	2.70	1,860	3.80	3,825	4.90	5,915
1.70	680	2.80	2,000	3.90	4,015	5.00	6,105
1.80	780	2.90	2,150	4.00	4,205	5.20	6,485
1.90	880	3.00	2,315	4.10	4,395	5.40	6,865
2.00	990	3.10	2,495	4.20	4,585	5.60	7,245
2.10	1,100	3.20	2,685	4.30	4,775	5.80	7,625
2.20	1,210	3.30	2,875	4.40	4,965	6.00	8,005
2.30	1,325	3.40	3,065	4.50	5,155	6.20	8,385
2.40	1,450	3.50	3,255	4.60	5,345	6.40	8,765
2.50	1,580	3.60	3,445	4.70	5,535	6.60	9,145

The preceding table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly well defined between gage heights 1.45 feet and 5.50 feet. The table has been extended beyond these limits. Above gage height 3.50 feet the rating curve is a tangent, the difference being 190 per tenth. Change in conditions due to obstructions placed in the river just below gage.

Estimated monthly discharge of Jefferson River near Sappington, Mont., for 1904.

[Drainage area, 8,984 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 1,400	86,083	0.156	0.180
February	.....	.....	[a] 1,400	80,529	.156	.168
March [b]	1,860	1,210	1,433	88,112	.159	.183
April	7,150	1,450	3,218	191,484	.358	.399
May	9,240	5,060	6,516	400,653	.725	.836
June	7,720	2,780	5,440	323,702	.606	.676
July	3,445	1,045	2,055	126,357	.229	.264
August	1,045	465	606	37,262	.067	.077
September	630	545	566	33,679	.063	.070
October	1,155	545	824	50,666	.092	.106
November	1,580	990	1,308	77,831	.146	.163
December [c]	1,720	1,100	1,353	83,193	.151	.174
The year	.....	.....	2,177	1,579,551	.242	3.296

[a] Estimated by C. C. Babb.
[b] March 10 to 31, inclusive. Mean for 22 days taken as mean for month.
[c] Discharge December 27 to 31 estimated 1,720 second feet.

SUN RIVER (NORTH FORK) NEAR AUGUSTA, MONT.

This station was established October 31, 1903, by C. T. Prall. It is located below Christian's ranch and below the head of Kilraven ditch, 14 miles northwest of Augusta and 21 miles southwest of Choteau, in Lewis and Clark County, Mont. The chain gage is on the left bank about 250 feet below the cable. The horizontal scale board is painted white, and is nailed to a plank, which is bolted to three posts set in the ground. The length of the chain from the end of the weight to the marker is 13.05 feet. The distance from the outside edge of the pulley to the zero of the scale is 4 feet. Bench mark No. 1 is the highest point of rock in Sun River, 12 feet upstream from gage. The size of the rock is 4 cubic yards. The elevation of the bench mark is 3.94 feet above the zero of the gage. Bench mark No. 2 is a nail in the root of a cottonwood tree 15 feet east of the gage. Its elevation is 14.47 feet above the zero of the gage. Bench mark No. 3 is a nail in

the post which supports the inshore end of the gage. Its elevation is 10.69 feet above the zero of the gage. Discharge measurements are made by means of a cable, car, tag wire, and stay wire. The channel is straight for about 300 feet above and 200 feet below the station. The right bank is low and may overflow at flood stages; the left bank is high and rocky. The bed of the stream is of solid rock. The current is sluggish. The initial point for soundings is the left cable strut. Owing to the impossibility of obtaining a regular observer but few gage readings were made during the year.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Sun River (North Fork) near Augusta, Mont., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
November 1	C. T. Prall	378	1.19	1.00	453
1904.					
July 8	A. P. Porter	518	2.73	2.42	1,416
July 9	do	522	2.86	2.45	1,492
July 19	do	404	1.88	1.70	760
September 8	do	291	.92	.81	269
November 12	L. R. Stockman	260	.60	.60	158

Mean daily gage height in feet of Sun River (North Fork) near Augusta, Mont., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
8	2.40		0.80			
9	2.45					
10	2.35					
11	2.30					
12					0.60	
15	1.95					
16	1.90					
17	1.80					
18	1.80					
19	1.70					
20	1.70					
21	1.65					
23	1.60					
25	1.55					
30					.60	

SUN RIVER (SOUTH FORK) NEAR AUGUSTA, MONT.

This station was established by Arthur P. Porter, December 2, 1904. It is located at the highway bridge on the road from Augusta to Craig, Mont., about one-half mile out of Augusta. The gage is a vertical rod, spiked to the cribwork of the east abutment on its downstream side. It is graduated to feet and tenths. The gage reader is Richard Auchard, and readings are made daily. The measurements are made from the upstream side of the single-span bridge. The initial point for sounding is at the east end of the hand rail, and this point, as well as the distances every 5 feet apart, is marked in white paint. The channel above the station is straight for a few feet and then curves to the right. Below it is straight for 30 feet, when it forks into two parts. The current is sluggish. Both banks are high and not liable to overflow. At the station the water passes between the cribworks of the bridge abutments. The river bed is made up of coarse gravel and cobblestones. Two sloughs on the east side and an irrigation ditch on the west side of the bridge carry water past the point of measurement. Bench mark is the head of a spike surrounded by a ring of nails in the top of the east abutment on the downstream side. It is 4.89 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurement of Sun River (South Fork) near Augusta, Mont., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
December 2....	A. P. Porter.....	51.4	0.45	1.30	23.3

Mean daily gage height in feet of Sun River (South Fork) near Augusta, Mont., for 1904.

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
2.....	1.30	10.....	1.20	18.....	1.30	26.....	(a)
3.....	1.30	11.....	1.30	19.....	1.20	27.....	1.50
4.....	1.30	12.....	1.30	20.....	1.20	28.....	1.45
5.....	1.30	13.....	1.30	21.....	1.20	29.....	1.50
6.....	1.50	14.....	1.15	22.....	1.20	30.....	1.30
7.....	1.55	15.....	1.10	23.....	1.00	31.....	1.20
8.....	1.25	16.....	1.20	24.....	1.30		
9.....	1.20	17.....	1.30	25.....	(a)		

a Ice.

MARIAS RIVER NEAR SHELBY, MONT.

This station was established April 4, 1902, by J. S. Baker. It is located at the highway bridge near J. A. Johnston's ranch, 7 miles south of Shelby, Mont., from which point it is reached by driving. The gage is of the standard chain type, and the scale board is spiked to the upstream hand rail of the bridge. The length of the chain from the weight to the marker was originally 22.06 feet, but had to be reduced November 16, 1904, to 21.97 feet, on account of settling of the bridge. It is read once each day by Elsie Bailey. Discharge measurements are made from the highway bridge, the lower chord of which is about 15 feet above low water. The initial point for soundings is the east end of the east bridge pier, on the lower side of the bridge, on the left bank. It is marked 0. The channel is straight for 300 feet above and 600 feet below the station. The current velocity is moderate. The right bank is sloping and sandy, and is liable to overflow. The left bank is high, and is protected by sheet piling and a plank wall. It may overflow at extreme flood stages. The bed of the stream is composed of sand and gravel, with some cobblestones; it is liable to shift after freshets. There is but one channel, and the current flows toward the left bank. Bench mark No. 1 is a rivet head in the footplate at the foot of the batter post on the top of the southeast pier. The plate is marked "B. M. 17.54" with black paint. The elevation of the bench mark above gage datum is 17.54 feet. Bench mark No. 2 is a spike in the southwest side of a cottonwood stump 25 feet southeast of the southeast pier. It is marked "B. M. 11.24." Its elevation above gage datum is 11.24 feet. Observations had to be discontinued November 19, 1904, on account of the only available observer leaving.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Marias River near Shelby, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 8	A. E. Place	170	546	4.31	4.02	2,359
May 20	L. R. Stockman	70	603	4.86	4.34	2,934
May 27	do	75	611	4.92	4.44	3,004
June 10	W. B. Freeman	178	604	4.63	4.31	2,798
June 29	Robert Follansbee	162	444	2.93	3.35	1,303
August 1	W. B. Freeman	143	271	1.83	2.44	495
September 5	do	135	204	1.13	1.97	231
November 16	L. R. Stockman	124	199	.93	1.80	184

Mean daily gage height, in feet, of Marias River near Shelby, Mont., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.00	.....	.....	.....	4.30	4.70	3.45	2.45	2.15	1.80	1.80
2	3.10	.....	.....	.....	4.30	4.80	3.35	2.45	2.15	1.80	1.80
3	3.10	.....	.....	.....	4.30	4.60	3.45	2.35	2.05	1.80	1.80
4	3.20	.....	.....	.....	4.40	4.40	3.55	2.35	2.05	1.80	1.80
5	3.20	.....	.....	.....	4.20	4.30	3.45	2.35	2.05	1.80	1.80
6	3.30	.....	.....	.....	4.10	4.40	3.35	2.35	1.95	1.80	1.80
7	3.30	.....	.....	.....	3.90	4.60	3.75	2.35	1.95	1.90	1.80
8	3.30	.....	.....	7.20	3.80	4.60	3.25	2.35	1.95	1.90	1.80
9	3.30	.....	.....	6.30	3.80	4.50	3.25	2.35	1.95	1.90	1.80
10	3.40	.....	.....	5.40	3.80	4.30	3.15	2.35	1.95	2.00	1.80
11	3.30	.....	.....	5.00	3.90	4.30	3.15	2.25	1.95	2.00	1.80
12	3.30	.....	.....	4.30	4.00	4.20	3.05	2.25	1.95	1.90	1.80
13	3.20	.....	.....	4.40	3.90	4.00	3.05	2.25	1.95	1.90	1.80
14	3.10	.....	.....	4.20	3.90	3.90	3.05	2.25	1.95	1.90	1.80
15	3.10	.....	.....	4.10	4.00	4.00	2.95	2.15	1.95	1.90	1.80
16	3.10	.....	.....	3.90	4.10	4.00	2.95	2.15	1.95	1.90	1.70
17	3.10	.....	.....	3.80	4.10	4.20	2.85	2.15	1.95	1.90	1.70
18	[a]3.00	.....	.....	3.50	4.20	4.40	2.75	2.15	1.95	1.90	1.70
19	.....	.....	.....	3.50	4.35	4.40	2.75	2.15	1.95	1.90	1.70
20	.....	.....	.....	3.80	4.40	4.20	2.65	2.15	1.95	1.90	[b]
21	.....	.....	.....	3.90	4.50	4.00	2.65	2.05	1.95	1.80	.....
22	.....	.....	.....	4.00	4.70	3.80	2.55	2.05	1.95	1.80	.....
23	.....	.....	.....	4.00	5.40	3.80	2.45	2.15	1.95	1.80	.....
24	.....	.....	.....	3.80	5.10	3.80	2.45	2.15	1.95	1.80	.....
25	.....	.....	.....	3.80	4.90	3.60	2.45	2.05	1.95	1.80	.....
26	.....	.....	.....	3.80	4.60	3.60	2.35	2.05	1.85	1.80	.....
27	.....	.....	.....	3.80	4.50	3.50	2.45	2.05	1.85	1.80	.....
28	.....	.....	.....	4.00	4.30	3.30	2.45	2.05	1.85	1.80	.....
29	.....	.....	.....	4.60	4.50	3.40	2.45	2.05	1.85	1.80	.....
30	.....	.....	.....	4.60	4.60	3.40	2.45	2.15	1.85	1.80	.....
31	.....	.....	.....	.....	4.70	.....	2.45	2.15	.....	1.80	.....

[a] River frozen January 18 to April 7, inclusive.
[b] Readings discontinued for lack of an observer.

Rating table for Marias River near Shelby, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	150	2.80	725	3.90	2,140	5.00	4,160
1.80	185	2.90	810	4.00	2,300	5.20	4,560
1.90	220	3.00	900	4.10	2,460	5.40	4,960
2.00	265	3.10	995	4.20	2,620	5.60	5,360
2.10	310	3.20	1,110	4.30	2,790	5.80	5,760
2.20	360	3.30	1,240	4.40	2,970	6.00	6,160
2.30	410	3.40	1,380	4.50	3,160	6.20	6,560
2.40	460	3.50	1,530	4.60	3,360	6.40	6,960
2.50	515	3.60	1,680	4.70	3,560	6.60	7,360
2.60	575	3.70	1,830	4.80	3,760	6.80	7,760
2.70	645	3.80	1,980	4.90	3,960		

The preceding table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 1.8 feet and 4.5 feet. The table has been extended beyond these limits. Above gage height 4.5 feet the rating curve is a tangent, the difference being 200 per tenth.

Estimated monthly discharge of Marias River near Shelby, Mont., for 1904.

[Drainage area, 2,610 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1 to 18, inclusive	1,380	900	[a]900	55,339	0.345	0.398
February			[a]800	46,016	.307	.331
March			[a]800	49,190	.307	.354
April 1 to 7, estimated	8,560	800	2,457	146,202	.941	1.050
May	4,960	1,980	2,848	175,117	1.091	1.258
June	3,760	1,240	2,495	148,463	.956	1.067
July	1,605	435	871	53,556	.334	.385
August	490	290	367	22,566	.141	.162
September	335	205	246	14,638	.094	.105
October	265	185	204	12,544	.078	.090
November [b]	185	150	168	9,997	.064	.071
December			[a]150	9,223	.057	.066
The year			1,017	742,851	.393	5.337

[a] Estimated. [b] Discharge estimated for November 20 to 30.

TETON RIVER NEAR BELLEVIEW, MONT.

This station was established November 26, 1904, by A. P. Porter. It is located in sec. 35, T. 25 N., R. 37 W., M. P. M., about 16 miles above Choteau, and near the house of Julius Bjornstad. The nearest post-office is Belleview, Mont. The gage is a vertical rod gage graduated to feet and tenths. It is spiked to a 2 by 4 inch post and set in a pit about 2 feet in diameter and about 40 feet above the head of an irrigation ditch. It is read daily by Julius Bjornstad. Stream measurements are made from a cable a short distance upstream. This is supported on one side by shears and a deadman; on the other, by trees. The tagged wire stretched over the cable is marked every 10 feet. The zero is at the left and serves as an initial point for soundings. The channel above the station is straight for about 200 feet at low water. At high water the river curves gradually from the left. Below the channel is straight for 75 feet. The bed is free from vegetation and consists of coarse gravel and cobblestones. A bar divides

the channel at low water. Some 100 feet downstream there are small rapids. The current is swift. Both banks are low and covered with thick underbrush and a few scattering trees. Bench mark No. 1 is a nail in a 10-inch cottonwood tree 8 feet from the road and 50 feet from the river bank. Its elevation is 5.43 above gage zero. Bench mark No. 2 is a nail in a 5-inch cottonwood tree 2 feet to the east of the road and 50 feet from the bank. Its elevation is 5 feet above gage zero. Bench mark No. 3 is a nail in a 20-inch cottonwood tree serving as a post in Bjornstad's small corral. Its elevation above the gage zero is 3.165 feet.

Observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurement of Teton River near Belleview, Mont., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
November 27 ..	A. P. Porter	38.2	1.52	0.60	58.0

Mean daily gage height, in feet, of Teton River near Belleview, Mont., for 1904.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		0.60	12		0.55	22		0.60
2		.60	13		.50	23		.60
3		.60	14		.50	24		.60
4		.55	15		.50	25		.70
5		.55	16		.50	26		
6		.50	17		.50	27	0.60	
7		.55	18		.50	28	.60	
8		.55	19		.60	29	.60	.65
9		.55	20		.60	30	.60	.40
10		.55	21		.60	31		.40
11		.55						

TETON RIVER NEAR CHOTEAU, MONT.

This station was established November 30, 1904, by A. P. Porter. It is located at the highway bridge on the road from Choteau to Augusta, Mont., and is about 1½ miles from the town of Choteau. The equipment consists of a chain gage fastened to the upstream hand rail of the bridge, and a graduated scale board. The distance from the tip of the weight to the marker is 14.73 feet. The marker is a a copper wire index. The gage is read gratuitously by J. W. Shields. The bridge, from the upstream side of which measurements are made, is a wooden structure resting on pile bents. The initial point for sounding is at the northeast end of the bridge, and is marked "0" in

white paint. The upstream hand rail is divided into 10-foot stations, and their distances from zero are painted. Above the station the channel is straight for 200 feet, below it curves to the right for about 50 feet. The current is swift. The river bed is clean from vegetation, and covered with rocks and coarse gravel. The bank is high on the right and low on the left, and is subject to overflow at high water. Bench mark No. 1 is a nail in a 3-inch plank just back of the floor beam at the west end of the bridge. It is marked with white paint and has an assumed elevation of 20.00 feet. Bench mark No. 2 is a nail 2 feet above ground in the trunk of a cottonwood tree 100 feet from the east end of the bridge, and in the fence on the south side of the road. Its elevation is 17.79 feet. The zero of the gage is 10.92 feet with reference to the bench marks. This gage was stolen before any observations could be made, and it was not replaced before the close of the year.

Discharge measurement of Teton River near Choteau, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
November 29 ..	A. P. Porter	15	5.8	1.25	1.8	7.3

MILK RIVER AT HAVRE, MONT.

This station was originally established by Cyrus C. Babb May 15, 1898. At that time a cable was stretched across the river not far from the highway bridge. The station was reestablished November 4, 1902, by L. V. Branch, when the cable was taken out and the station was transferred to the highway bridge, at which it is now located. The original wire gage was replaced January 12, 1904, by a standard chain gage, which was made to read the same as the old gage. The length of chain from the end of the weight to the marker is 25.3 feet. The marker is a ring of fine copper wire wrapped around the chain. It is placed 0.85 foot from the end of the cast-iron ring at the end of the chain. The scale is nailed to the floor of the bridge on the downstream side 90 to 100 feet from the initial point for soundings. It is boxed, and reads from 2.5 to 10.5 feet. The gage pulley is located at a point which corresponds to a reading of 2 feet on the scale. L. H. Ling, who reads the gage, is the United States Weather Bureau observer. Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is marked on the downstream guard rail at the right bank. The channel is straight above for a short distance, when a sharp curve occurs. Below the station it is straight. The current is sluggish at ordinary stages. Both banks are high above all ordinary floods, and

are not wooded. The bed of the stream is shifting and is liable to change after each freshet. The bridge from which the measurements are made makes an angle of 20 degrees with the normal to the current. The datum used in the establishment of the bench marks is that of the city of Havre, deduced from a destroyed temporary bench mark of the United States Geological Survey. Bench mark No. 2 is a 20-penny nail in a cottonwood tree 100 feet southwest of the southwest pier of the bridge. Its elevation is 2,477.44 feet. Bench mark No. 3 is a standard United States Geological Survey bench-mark plate in the stone pier of a column supporting the Great Northern Railway water tank one-half mile southeast of the bridge and near the round-house. It is marked 2,483. The correct elevation is 2,482.46 feet. There is also a temporary bench mark on the top of the southeast corner of the lid of the gage box. Its elevation is 2,488.60 feet.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Milk River at Havre, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 12	A. E. Place	172	744	3.86	7.78	2,866
May 5	do	168	289	2.03	5.18	588
May 19	L. R. Stockman	75	124	2.90	4.37	359
May 26	do	90	159	1.69	4.43	289
June 4	E. C. Murphy and W. B. Freeman.	155	252	1.73	4.93	435
June 30	Robert Follansbee	62	70	1.34	3.47	95
July 18	do	56	37	1.19	3.02	44
August 1	W. B. Freeman	24	11	1.10	2.80	12
August 10	do	7	5	.69	2.45	3

Mean daily gage height, in feet, of Milk River at Havre, Mont., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				4.60	4.80	4.80	3.40	2.80	2.40	2.50	2.80
2				4.70	4.80	5.00	3.40	2.65	2.50	2.60	2.85
3				7.00	5.00	5.00	3.40	2.60	2.60	2.50	2.80
4				8.00	5.00	4.90	3.40	2.50	2.60	2.50	2.80
5				8.80	5.20	4.70	3.40	2.50	2.60	2.40	2.90
6				8.00	5.20	4.60	3.30	2.40	2.50	2.40	2.90
7				9.30	5.00	4.60	3.30	2.40	2.50	2.50	2.90
8				8.20	4.90	4.70	3.30	2.45	2.50	3.00	2.90
9				7.80	4.90	4.80	3.30	2.40	2.40	2.90	2.90
10				7.30	4.90	4.80	3.10	2.40	2.40	2.80	2.90
11				6.80	4.80	4.90	3.00	2.40	2.40	2.70	2.90

[a] River frozen January 1 to March 30, inclusive; also during December.

Mean daily gage height, in feet, of Milk River at Havre, Mont., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
12				8.00	4.80	4.60	3.00	2.30	2.30	2.70	2.90
13				9.30	4.60	4.60	3.00	2.25	2.40	2.70	2.90
14				8.00	4.45	4.50	3.00	2.25	2.40	2.60	2.90
15				7.00	4.40	4.40	3.00	2.20	2.40	2.80	2.90
16				6.70	4.50	4.40	3.00	2.10	2.40	2.80	2.90
17				6.20	4.50	4.10	3.00	2.10	2.35	2.80	2.90
18				5.90	4.50	4.15	3.00	2.10	2.30	2.80	3.10
19				5.60	4.40	4.10	2.90	2.10	2.30	2.90	3.10
20				5.30	4.30	4.10	2.90	2.10	2.30	2.90	3.00
21				5.10	4.20	4.00	2.90	2.20	2.30	2.90	3.00
22				5.00	4.20	4.00	2.85	2.50	2.20	2.90	3.00
23				5.10	4.30	3.80	2.85	2.40	2.20	2.80	3.00
24				5.30	4.60	3.70	2.80	2.50	2.20	2.80	3.00
25				5.30	4.80	3.60	2.70	2.50	2.20	2.80	3.00
26				5.00	4.55	3.70	2.70	2.60	2.20	2.80	3.00
27				5.20	4.50	3.60	2.60	2.60	2.20	2.80	3.00
28				5.10	4.55	3.60	2.60	2.50	2.20	2.80	3.00
29				4.90	4.70	3.60	2.60	2.40	2.20	2.80	3.00
30				4.80	4.70	3.50	2.60	2.40	2.40	2.80	3.00
31			4.50		4.70		2.60	2.40		2.80	

Rating table for Milk River at Havre, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	1	3.60	120	5.00	490	6.80	1,750
2.30	2	3.70	135	5.10	535	7.00	1,950
2.40	3	3.80	150	5.20	580	7.20	2,165
2.50	5	3.90	170	5.30	630	7.40	2,390
2.60	10	4.00	190	5.40	685	7.60	2,630
2.70	15	4.10	210	5.50	745	7.80	2,880
2.80	22	4.20	230	5.60	805	8.00	3,140
2.90	31	4.30	255	5.70	870	8.20	3,400
3.00	41	4.40	280	5.80	935	8.40	3,665
3.10	51	4.50	310	5.90	1,005	8.60	3,935
3.20	63	4.60	340	6.00	1,075	8.80	4,205
3.30	75	4.70	375	6.20	1,225	9.00	4,480
3.40	90	4.80	410	6.40	1,390	9.20	4,760
3.50	105	4.90	450	6.60	1,565		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is fairly well defined between gage heights 2.45 feet and 7.80 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Milk River at Havre, Mont., for 1904.

[Drainage area, 7,300 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a]90	5,534	0.012	0.014
February	.....	.....	[a]75	4,314	.010	.011
March	.....	.....	[a]75	4,612	.010	.012
April	4,900	340	1,736	103,299	.238	.266
May	580	230	373	22,935	.051	.059
June	490	105	278	16,542	.038	.042
July	90	10	44	2,705	.006	.007
August	22	0	5	307	.000	.000
September	10	1	3	178	.000	.000
October	41	3	19	1,168	.003	.003
November	51	22	35	2,083	.005	.006
December	.....	.....	[a]25	1,537	.003	.003
The year	.....	.....	230	165,214	.031	.423

[a] Estimated by C. C. Babb.

MILK RIVER AT MALTA, MONT.

This station was established July 31, 1902, by C. T. Prall. It is located at the highway bridge on the main road one-fourth mile east of the railroad station and post-office at Malta, Mont. The original wire gage has been replaced by a standard boxed chain gage, reading the same as the old one. It is fastened to the lower downstream guard rail of the highway bridge. The length of the chain from the end of the weight to the marker is 28.67 feet. The distance from the zero of the scale to the outside edge of the pulley is 0.5 foot. The marker is a small copper ring near the ring at the end of the chain. The gage is read once each day by S. C. Loyd. Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is a spike on the downstream guard rail at the right bank. It is marked zero with paint. The channel is straight for about 700 feet above and 250 feet below the station. The current velocity is moderate. Both banks are high and sandy and are not liable to overflow. The water passes beneath the bridge at all stages. The bed of the stream is composed of sand and gravel, and there is but one channel. The bench mark is a paint mark on the east end of a plank spiked to the south abutment. It is marked "B. M. U. S. G. S." Its elevation above gage datum is 13.66 feet, and the elevation of the latter above sea level is 2,221.40,

or 37.80 feet below the United States Geological Survey datum at the Malta schoolhouse.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Milk River at Malta, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 8[a]	W. B. Freeman	150	1,261	2.51	10.45	3,162
April 10	do	153	1,962	4.14	14.35	8,116
April 11	do	153	1,682	4.16	12.57	7,002
April 12	do	145	1,530	4.55	11.94	6,966
April 13	do	145	1,536	4.44	12.07	6,830
April 13	do	145	1,505	4.35	11.83	6,545
April 15	do	145	1,467	4.49	11.82	6,583
April 18	do	143	1,077	4.45	9.47	4,798
April 18	do	143	990	4.52	8.85	4,475
April 19	do	142	830	4.64	7.80	3,853
April 19	do	141	736	4.73	7.12	3,483
April 20	do	135	575	4.86	6.06	2,792
April 20	do	131	485	5.10	5.52	2,470
April 21	do	116	386	4.85	4.84	1,871
April 22	do	106	333	4.70	4.43	1,566
April 23	do	106	327	4.38	4.19	1,432
April 24	do	103	321	4.40	4.07	1,408
April 24	do	103	321	4.33	4.07	1,390
April 26	do	100	313	4.41	4.06	1,381
April 30	do	94	262	4.03	3.62	1,056
May 5	do	95	236	4.00	3.29	942
May 5	W. M. Neptune	98	238	3.57	3.29	850
May 17	Robert Follansbee	86	160	2.66	2.42	425
May 25	do	83	130	2.52	2.20	327
June 4	W. B. Freeman and E. C. Murphy.	87	146	3.45	2.37	503
June 6	Robert Follansbee	138	476	4.59	5.35	2,182
June 7	do	135	468	4.97	5.08	2,324
June 9	do	110	318	4.34	3.98	1,382
June 13	do	93	196	3.07	2.90	601
June 15	do	92	188	3.12	2.86	588
July 5[b]	do	22	21	2.09	1.34	44
July 9[b]	do	20	19	1.00	1.06	19
July 20[b]	do	18	14	.41	.90	6.6
July 28	do	.....	.....	.....	.71	[c]1

[a] Ice gorge. [b] By wading at different sections. [c] Estimated.

Mean daily gage height, in feet, of Milk River at Malta, Mont., for 1904.

Date.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.55	.....	.....	.....	3.65	2.00	1.30	0.70	0.30	0.30	0.30	1.00
2	1.55	.....	.....	.....	3.65	2.10	1.30	.70	.30	.30	.30	1.00
3	1.75	.....	.....	1.75	3.55	2.00	1.30	.70	.30	.30	.30	1.00
4	2.65	.....	.....	2.85	3.55	2.00	1.30	.70	.30	.30	.30	1.00
5	2.55	1.65	1.65	[b]5.85	3.35	4.60	1.30	.70	.30	.30	.30	1.00
6	2.45	.....	.....	8.35	3.25	5.30	1.30	.70	.30	.30	.30	1.00
7	2.45	.....	.....	9.35	3.15	4.40	1.20	.70	.30	.30	.30	1.00
8	2.35	.....	.....	10.55	3.05	4.00	1.10	.70	.30	.30	.30	1.00
9	2.15	.....	.....	[c]15.15	3.05	3.50	1.05	.70	.30	.30	.30	1.00
10	1.95	1.65	1.65	15.15	2.95	3.30	1.05	.65	.30	.30	[d].50	1.00
11	1.65	.....	.....	12.55	2.95	2.90	1.05	.65	.30	.30	1.30	1.00
12	1.55	.....	.....	11.95	2.85	2.90	1.00	.65	.30	.30	1.30	1.00
13	1.55	.....	.....	12.05	2.75	2.90	1.00	[d].60	.30	.30	1.30	1.00
14	1.45	.....	.....	11.45	2.65	2.80	1.00	.55	.30	.30	1.20	1.00
15	1.35	1.65	1.65	11.45	2.55	2.80	1.00	.55	.30	.30	1.10	1.00
16	1.35	.....	.....	11.45	2.45	2.70	1.00	.55	.30	.30	1.00	1.00
17	1.35	.....	.....	11.65	2.35	2.40	.90	.50	.30	.30	1.00	1.00
18	1.65	.....	.....	9.45	2.25	2.30	.90	.45	.30	.30	1.00	1.00
19	1.65	.....	.....	7.95	2.25	2.20	.90	.40	.30	.30	1.00	1.00
20	2.45	1.65	1.65	6.05	2.25	2.10	.90	.40	.30	.30	1.00	1.00
21	1.75	.....	.....	4.85	2.35	2.10	.90	.40	.30	.30	1.00	1.00
22	1.75	.....	.....	4.45	2.20	2.00	.85	.40	.30	.30	1.00	1.00
23	[e]1.65	.....	.....	4.25	2.50	1.90	.80	.40	.30	.30	1.00	1.00
24	1.65	.....	.....	4.05	2.30	1.80	.80	.40	.30	.30	1.00	1.00
25	1.65	1.65	1.65	4.05	2.20	1.70	.80	.40	.30	.30	1.00	1.00
26	1.65	.....	.....	4.05	2.10	1.60	.80	.40	.30	.30	1.00	1.00
27	1.65	.....	.....	4.05	1.90	1.60	.80	.40	.30	.30	1.00	1.00
28	1.65	.....	.....	4.05	1.90	1.50	.70	.40	.30	.30	1.00	1.00
29	1.65	.....	.....	3.75	2.00	1.40	.70	.40	.30	.30	1.00	1.00
30	1.65	.....	.....	3.55	2.10	1.30	.70	.40	.30	.30	1.00	1.00
31	1.65	.....	.....	.....	2.10	.....	.70	.40	.....	.30	.....	1.10

[a] River frozen January 1 to April 3, when ice goes out at station.
[b] April 5 to 10, water backed up by ice jam.
[c] Maximum gage height, 16 feet (approximate).
[d] No flow August 13 to November 10. Water standing in pools.
[e] January 23 to April 3, gage height is 1.65 read to ice.

Rating table for Milk River at Malta, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	1	2.50	472	4.60	1,735	8.20	4,075
.80	4	2.60	520	4.80	1,865	8.40	4,205
.90	8	2.70	568	5.00	1,995	8.60	4,335
1.00	15	2.80	618	5.20	2,125	8.80	4,465
1.10	24	2.90	670	5.40	2,255	9.00	4,595
1.20	34	3.00	722	5.60	2,385	9.50	4,945
1.30	45	3.10	778	5.80	2,515	10.00	5,295
1.40	58	3.20	834	6.00	2,645	10.50	5,645
1.50	76	3.30	894	6.20	2,775	11.00	5,995
1.60	102	3.40	958	6.40	2,905	11.50	6,345
1.70	136	3.50	1,022	6.60	3,035	12.00	6,695
1.80	174	3.60	1,086	6.80	3,165	12.50	7,045
1.90	214	3.70	1,150	7.00	3,295	13.00	7,395
2.00	254	3.80	1,215	7.20	3,425	13.50	7,745
2.10	294	3.90	1,280	7.40	3,555	14.00	8,095
2.20	336	4.00	1,345	7.60	3,685	14.50	8,445
2.30	380	4.20	1,475	7.80	3,815	15.00	8,795
2.40	424	4.40	1,605	8.00	3,945		

The above table is applicable only for open-channel conditions. It is based upon 34 discharge measurements made during 1904. It is well defined between point of zero flow and 14 feet gage height. Above gage height 9 feet the rating curve is a tangent, the difference being 70 per tenth.

Estimated monthly discharge of Milk River at Malta, Mont., for 1904.

[Drainage area, 14,044 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 100	6,149	0.007	0.008
February	.....	.....	[a] 80	4,602	.006	.006
March	.....	.....	[a] 80	4,919	.006	.007
April[b]	8,794	100	3,268	194,460	.233	.260
May	1,118	214	565	34,740	.040	.046
June	2,190	45	552	32,846	.039	.044
July	45	1	17	1,045	.001	.001
August	1	0	[a] 1	61	.....	.....
September	0	0	0	0	.....	.....
October	0	0	0	0	.....	.....
November	45	0	[a] 14	833	.001	.001
December	24	15	15	922	.001	.001
The year	.....	.....	391	280,577	.028	.374

[a] Estimated. [b] April 1–10, inclusive, estimated.

SEEPAGE MEASUREMENTS ALONG MILK RIVER BETWEEN HAVRE AND GLASGOW, MONT., IN 1904.

During August, 1904, a series of seepage measurements were made along Milk River from Havre to Glasgow, Mont., by W. B. Freeman. The river was practically dry along certain stretches, a condition existing not oftener than once in from five to ten years.

The canals in the vicinity of Chinook, noted below, have been in operation about ten years. It is seen that the return water from seepage is very small, the maximum being 0.10 second-foot per mile. These results will be of value in comparison with future measurements as irrigation develops in the valley.

ients:

sgow, Mont., in 1904.

iver.	Gain or loss.	
	Total.	Per mile.
sec.-feet.	*Sec.-feet.*	*Sec.-feet.*
3.4	.....	.....
2.9	+ 2.1	0.10
2.0	.....	.....
3.0	+ 3.4	.10
2.3	+ .3	.03
1.4	+ 1.1	.05
1.0	— .4	.....
[b] 27.5	+26.5	.17

Rock creeks, and other tributaries

.NOOK, MONT.

ctive company of farmers.
nds near Chinook, Mont.
, by L. E. Granke. It is
canal at the highway cross-
ook, Mont. The gage is a
chord of the wooden bridge.
the wooden highway bridge,
tial point for soundings is a
end of the downstream hand
re marked by spikes every 3
e bed is composed of sand.
f a large cottonwood tree 300
ion is 3.91 feet above the zero
level. Bench mark No. 2 is a
st of the bridge. This has an
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Discharge measurements of Fort Belknap canal near Chinook, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 9 [a]	A. E. Place	27.0	41.0	2.07	2.34	85
May 19	L. R. Stockman	32.0	55.0	1.36	2.93	75
June 30	Robert Follansbee	33.0	59.0	1.50	3.00	90
August 9	W. B. Freeman	7.8	3.3	.79	.81	2.5

[a] Head-gates being opened during measurement.

Mean daily gage height, in feet, of Fort Belknap canal near Chinook, Mont., for 1904.

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1	.....	3.70	2.75	12	2.70	1.70	2.20	23	3.80	3.20	1.80
2	.....	3.60	2.80	13	2.80	1.65	2.20	24	3.80	3.20	.....
3	.....	2.30	2.70	14	2.70	1.60	2.20	25	3.80	3.10	.....
4	.....	2.30	2.65	15	2.70	1.60	2.20	26	3.90	3.00	.....
5	.....	2.30	2.60	16	2.70	1.60	2.20	27	3.80	2.90	.....
6	.....	2.30	2.55	17	2.80	3.00	2.25	28	3.80	2.85	.....
7	.....	2.20	2.50	18	2.70	3.20	2.25	29	3.80	2.90	.....
8	.....	2.20	2.40	19	2.90	3.30	2.20	30	3.80	2.80	.....
9	[a] 2.30	2.20	2.40	20	2.80	3.25	2.10	31	3.80	.....	.....
10	2.70	1.80	2.30	21	3.60	3.30	2.00				
11	2.60	1.60	2.20	22	3.70	3.20	1.90				

[a] Canal operated from May 2 to July 23, when it was closed for lack of water.

Rating table for Fort Belknap canal near Chinook, Mont., for irrigation seasons of 1903 and 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	18	2.20	40	2.80	70	3.40	100
1.70	21	2.30	45	2.90	75	3.50	105
1.80	24	2.40	50	3.00	80	3.60	110
1.90	28	2.50	55	3.10	85	3.70	115
2.00	31	2.60	60	3.20	90	3.80	120
2.10	35	2.70	65	3.30	95	3.90	125

Curve is well defined only at the extreme upper and lower limits. Curve extended above gage height 3.13 feet.

Estimated monthly discharge of Fort Belknap canal near Chinook, Mont., for 1903 and 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1903.				
June 21 to 30, inclusive	107	87	100	1,983
July 1 to 4, inclusive	92	87	90	714
1904.				
May 9 to 31, inclusive	125	45	91	4,151
June	115	18	61	3,630
July 1 to 23, inclusive	70	24	46	2,098

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

Paradise Valley canal is owned by a cooperative company of farmers. It irrigates bottom lands several miles east of Chinook, Mont. The station was established in June, 1903, by C. T. Prall. It is located near the South River road, 7 miles east of Chinook, from which place it is reached by driving. The gage is a vertical board driven into the bed of the canal about 500 feet below the head-gates and fastened to a measuring footbridge near the house of the observer, Rudolph Friede. Discharge measurements are made from the above-mentioned footbridge. The initial point for soundings is the "0" on the footbridge at the left bank. The channel is straight, and the section at the station is semicircular. The bed of the canal is composed of mud and sand. This canal carries water only during the irrigating season. Bench mark No. 1 is a spike in the top of a 6 by 6 inch post on the left side of the downstream end of the head-gate. Its elevation above gage datum is 7.29 feet. Bench mark No. 2 is a spike in the southwest side of a 12-inch post 40 feet south of the south end of the dam and 28 paces east of bench mark No. 1. Its elevation above gage datum is 7.38 feet.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Paradise Valley canal near Chinook, Mont., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 18	L. R. Stockman	9.1	0.79	0.82	7.2
June 30	Robert Follansbee	8.7	.60	1.20	5.3
August 9	W. B. Freeman	7.3	.73	1.01	5.3

Mean daily discharge,[a] in second-feet, of Paradise Valley canal near Chinook, Mont., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	5.0	6.5	5.0	.....	.....
2	.....	15.0	7.5	5.0	.....	.....
3	.....	8.0	7.5	6.0	.....	.....
4	.....	5.0	8.0	6.0	.....	.....
5	.....	5.0	9.0	6.0	.....	.....
6	.....	7.0	9.0	6.0	.....	.....
7	.....	6.0	9.0	6.0	.....	.....
8	.....	5.0	9.0	5.0	.....	.....
9	.....	2.5	8.0	5.0	.....	.....
10	.....	2.5	8.0	5.0	.....	.....
11	5.5	.5	10.0	5.0	.....	0 5
12	3.0	1.0	10.0	4.0	.....	1.0
13	1.0	1.0	10.0	3.5	.....	.5
14	.0	.0	9.5	3.5	.....	.5
15	8.0	.....	9.5	3.0	.....	.....
16	8.0	.....	7.5	3.0	.....	.....
17	8.0	3.5	3.5	2.5	.....	.5
18	2.5	1.0	4.5	2.5	.....	1 0
19	14.5	1.0	6.5	2.0	.....	2.0
20	16.0	.....	7.5	2.5	.....	2 0
21	11.5	3.5	8.5	1.0	.....	.....
22	6.5	2.5	7.5	1.0	.....	.....
23	5.0	.....	9.5	1.0	.....	.....
24	8.0	5.5	10.0	.5	.....	.....
25	10.5	10.0	10.0	.....	.....	.....
26	13.5	10.0	8.5	.....	.....	.....
27	10.5	10.0	6.5	.....	.....	.....
28	10.0	9.0	6.5	.....	.....	.....
29	8.0	7.5	6.5	.....	.....	.....
30	7.5	7.5	2.5	.....	.....	.....
31	8.0	.....	4.0	.....	.....	.....

[a] No flow during 1904 except as given in the above table.

NOTE.—Owing to the alternate silting up and cleaning out of the canal one curve for the season is impossible. The discharge has been estimated from a series of parallel curves.

Estimated monthly discharge of Paradise Valley canal near Chinook, Mont., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 11 to 31, inclusive	16	0	8	333
June	15	0	4	238
July	10	2.5	8	492
August	6	0	3	184
October 11 to 20, inclusive	2	0	1	20

HARLEM CANAL NEAR ZURICH, MONT.

Harlem canal is owned by a cooperative company of farmers. It irrigates a considerable area of bottom lands near Harlem, Mont.

The station was established in June, 1903, by C. T. Prall. It is

located about 500 feet below the head-gates of the canal and about 1 mile southeast of the Great Northern Railroad section house at Zurich, Mont. It is best reached by driving from Harlem or Chinook, Mont. The gage is a vertical board driven into the bed of the canal. The gage is read daily during the irrigating season by John Palm. Discharge measurements are made from a small bridge 2 miles below the gage on the road from Harlem to Cleveland, or by wading near the gage board. The initial point for soundings is a stake driven into the left bank opposite the gage. The bench mark is a spike in the downstream face of the 6 by 8 inch post on the left and on the downstream end of the head-gate. This spike is about 10 inches below the top of the cross piece, and is at an elevation of 11.89 feet above the gage datum. Two bench marks were established at the lower measuring station, No. 1 being a spike in upstream end of bed piece on left abutment 2.10 feet from outside of lower chord. It is 6.62 feet above the gage datum. No. 2 is a spike on west side of south gate post, 26 paces south of right end of bridge. Elevation, 4.44 above gage datum.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Harlem canal near Zurich, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 18	L. R. Stockman	20.6	54.0	0.92	2.62	49.6
July 1	Robert Follansbee	20.0	47.6	.50	1.60	24.0
August 8	W. B. Freeman	7.5	2.5	.40	.58	1.0

Mean daily gage height, in feet, of Harlem canal near Zurich, Mont., for 1904.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	.....	2.60	1.55	0.70	17	2.10	1.90	.90	.55
2	.....	2.85	1.45	.70	18	2.50	2.00	.90	.50
3	.....	2.65	1.30	.60	19	2.50	2.00	.80	.50
4	.....	2.70	1.00	.60	20	2.40	1.85	.80	.50
5	.....	2.65	.90	.60	21	2.20	1.90	.80	.....
6	.....	2.60	.75	.50	22	2.05	1.85	.70	.....
7	.....	2.45	.60	.60	23	2.15	1.80	.70	.....
8	.....	2.30	.60	.60	24	2.35	1.30	.60	.....
9	.....	2.20	.60	.60	25	2.50	1.35	.60	.....
10	.....	2.20	.60	.60	26	2.60	1.40	.55	.....
11	1.80	2.20	.60	.60	27	2.55	1.50	.50	.....
12	1.90	2.20	.60	.60	28	2.50	1.55	.50	.....
13	2.00	2.35	.60	.60	29	2.50	1.65	.60	.....
14	2.10	2.50	.70	.50	30	2.55	1.80	.70	.....
15	2.00	2.00	.70	.50	31	2.60	.....	.70	.....
16	2.00	2.00	.80	.55					

Canal operated April 1 to August 20.

Rating table for Harlem canal near Zurich, Mont., for irrigation seasons of 1903 and 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	1	1.30	15	2.00	33	2.70	52
.70	2	1.40	17	2.10	36	2.80	55
.80	4	1.50	20	2.20	39	2.90	57
.90	6	1.60	23	2.30	41	3.00	60
1.00	8	1.70	25	2.40	44		
1.10	10	1.80	28	2.50	47		
1.20	12	1.90	30	2.60	50		

Curve fairly well determined. Curve extended above gage height 2.62 feet.

Estimated monthly discharge of Harlem canal near Zurich, Mont., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 11 to 31, inclusive	50	28	41	1,705
June	56	15	35	2,083
July	21	0	4	246
August 1 to 13, inclusive	2	0	1	26

BEAVER CREEK NEAR ASHFIELD, MONT.

The original station was established July 5, 1903, by A. E. Place. It was located at railroad bridge No. 455 of the Great Northern Railroad, one-fourth mile west of Ashfield, Mont. The gage was read once each day by John Borek, and consisted of a vertical board gage in two sections fastened to the left abutment and to some old piles near the channel. Discharge measurements were made from the railroad bridge. The bench mark was a spike in the pile to the left of the upper part of the gage, and was marked "U. S. G. S. B. M." Its elevation above the zero of the gage was 7 feet. This station was discontinued in December, 1903, on account of the influence of the backwater from a dam completed August 2, 1903, about 1 mile below. A new station was established December 31, 1903, by W. B. Freeman, at a point 2½ miles farther upstream, at the Thomas & Gould ranch, and above the influence of the dam. The new station is 18 miles from Malta, Mont. The gage is an inclined 2 by 6 inch plank securely fastened to posts set in the ground at each end, and has a vertical

extension which gives minus readings in very low water. Later tests of the gage rod showed the same to read 0.01 foot too great per foot vertical. Discharge measurements are made from a ½-inch steel cable about 225 yards above the gage. The cable has a span of 100 feet between supports. A car is suspended from the cable, and a tag wire has been installed and marked at intervals of 5 feet. The initial point for soundings is a nail in the cable support on the left bank. The channel is straight for 300 feet above and below the cable. The right bank is sloping and covered with willows and is not liable to overflow. The left bank is steep and is also covered with willows. The stream has a sluggish velocity. The bed of the stream is composed of mud, and there is but one channel. Bench mark No. 1 is the top of a nail driven flush in the top of a 2 by 4 stake 12½ feet south of the gage. Elevation, 11.432 feet above zero of gage. Bench mark No. 2 is the top of a railroad spike driven in the northwest corner of Thomas's house 1 foot above ground. Elevation, 13.346 feet above zero of gage. Gage readings were made during the last year by R. H. Thomas and A. H. Gould.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Beaver Creek near Ashfield, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 6	W. B. Freeman	62	316	1.11	7.15	352
April 7	do	63	337	1.28	7.55	433
April 9[a]	do	63	471	2.70	10.40	1,272
April 11	do	58	233	1.18	5.76	276
April 14	do	44	74	1.19	2.37	88
May 13	C. C. Babb				—.60	[b] 0.5

[a] Float measurement. [b] Estimated.

Mean daily gage height, in feet, and discharge, in second-feet, of Beaver Creek near Ashfield, Mont., for 1904.

Day.	April.		May.		Day.	April.		May.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1			0.10	5	16	2.20	83		
2			.10	5	17	2.40	91		
3			.05	4	18	2.20	83		
4			.05	4	19		67		
5			.00	3	20	1.35	49		
6	6.80	338	.05	1	21	1.10	39		
7	a10.00	1,728			22	.95	33		
8	11.65	1,623			23	.85	29		
9	10.50	1,278			24		23		
10	8.60	708			25	.55	18		
11	5.80	278			26	.45	15		
12	4.40	194			27	.35	12		
13	3.50	140			28	.30	11		
14		115			29	.20	8		
15	2.45	93			30	.15	6		

a Reservoir broke above gaging station.

NOTE.—Creek dry except from April 6 to May 6.

Rating table for Beaver Creek near Ashfield, Mont., from April 6 to May 6, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.05	1	1.20	43	2.50	95	4.60	206
.00	3	1.30	47	2.60	99	4.80	218
.10	5	1.40	51	2.70	103	5.00	230
.20	8	1.50	55	2.80	107	5.50	260
.30	11	1.60	59	2.90	111	6.00	290
.40	14	1.70	63	3.00	115	6.50	320
.50	17	1.80	67	3.20	125	7.00	350
.60	20	1.90	71	3.40	135	7.50	410
.70	23	2.00	75	3.60	146	8.00	528
.80	27	2.10	79	3.80	158	9.00	828
.90	31	2.20	83	4.00	170	10.00	1,128
1.00	35	2.30	87	4.20	182	11.00	1,428
1.10	39	2.40	91	4.40	194		

Curve extended above highest measurement. Above 7 gage height curve is not well determined, and the extreme upper part is determined by one float measurement.

Estimated monthly discharge of Beaver Creek near Ashfield, Mont., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 6 to 30, inclusive	1,623	6	258	12,793	0.234	0.218
May 1 to 6, inclusive.	5	1	4	48	.004	.001

BEAVER CREEK OVERFLOW CHANNEL NEAR BOWDOIN, MONT.

This station was established June 29, 1903, by C. C. Babb. It is located on an overflow channel of Beaver Creek, about 4 miles southeast of the Great Northern Railroad station at Bowdoin, Mont. It is reached best by wagon from Malta, Mont., 12 miles distant. The water supply is partly due to natural drainage of irrigated lands and partly to water wasted over the spillway at the dam above on Beaver Creek. The gage is a vertical board nailed to a cottonwood tree about 100 feet above the cable. It is graduated to tenths of feet and marked with black paint. The gage is read once each day by John Turmell. Discharge measurements are made by means of a cable, car, and tagged wire, and also by wading. The initial point for soundings is the east side of a post on the west or left bank near the wire fence crossing the channel. The channel is straight for 200 feet above the station and for 100 feet below. The stream is sluggish. During high floods both banks will be submerged, as at that time the whole valley is flooded. The bed of the stream at the station forms a small bar covered with weeds and swamp grass. Bench mark No. 1 is a nail in a hub 1 foot south of the back of the gage. Its elevation is 5.79 feet above the zero of the gage and is 2,213.6 feet above sea level. Bench mark No. 2 is a nail in the northwest corner of Turmell's house. Its elevation above the zero of the gage is 17.64 feet. The elevation of these bench marks has been determined from the bench mark at the Malta schoolhouse. Its elevation is based on the elevation of the rail in front of the Great Northern Railroad station at Malta, Mont.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Beaver Creek overflow channel near Bowdoin Mont., in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 21	C. C. Babb	.....	42	0.34	4.15	14.1
August 10	....do	.....	.....	.....	3.30	a 2
1904.						
April 6	W. B. Freeman	123	420	1.54	8.40	646
April 7	....do	132	529	2.72	9.15	1,480
April 9	....do	128	463	2.03	8.70	942
April 12	....do	100	276	1.37	7.10	379
April 14	....do	56	58	.98	4.80	57
April 20	....do	6	24	1.12	3.68	2.7

a Estimated.

Mean daily gage height, in feet, and discharge in second-feet, of Beaver Creek overflow channel near Bowdoin, Mont., for 1903.

Day.	July.		August.		Day.	July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
2	.....	.....	3.25	.....	16	3.50	2	.....	.....
3	.....	.....	3.40	1	17	5.80	166	.....	.....
4	.....	.....	3.60	3	18	6.40	249	.....	.....
5	.....	.....	3.50	2	19	5.90	178	.....	.....
6	.....	.....	3.50	2	20	5.40	118	.....	.....
7	2.70	.....	3.45	1	21	4.60	41	.....	.....
8	3.70	4	3.40	1	22	3.70	4	.....	.....
9	3.60	3	3.30	(a)	23	3.50	2	.....	.....
10	4.70	49	.....	.....	24	3.40	1	.....	.....
11	5.00	74	.....	.....	25	3.43	1	.....	.....
12	4.50	33	.....	.....	26	3.40	1	.....	.....
13	3.80	5	.....	.....	27	3.36	1	.....	.....
14	3.60	3	.....	.....	28	3.33	.....	.....	.....
15	3.50	2	.....	.....					

a Dry for rest of year.

Mean daily gage height, in feet, and discharge in second-feet, of Beaver Creek overflow channel near Bowdoin, Mont., for 1904.

Day.	April.		Day.	April.		Day.	April.	
	Gage height.	Discharge.		Gage height.	Discharge.		Gage height.	Discharge
5	7.00	360	13	5.75	160	21	3.60	3
6	8.40	792	14	4.90	65	22	3.60	3
7	9.30	1,740	15	5.10	84	23	3.60	3
8	8.90	1,092	16	4.45	30	24	3.60	3
9	8.70	952	17	3.90	7	25	3.60	3
10	8.45	816	18	3.70	4	26	3.50	.....
11	8.20	712	19	3.70	4	27	3.40	.....
12	6.85	330	20	3.70	4	28	3.30	.....

Note: Channel dry except April 5–25, inclusive.

Estimated monthly discharge of Beaver Creek overflow channel near Bowdoin, Mont., for 1903 and 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1903.				
July 8 to 27, inclusive	249	1	47	1,864
August 3 to 8, inclusive	3	1	2	24
1904.				
April 5 to 25, inclusive	1,740	3	341	14,204

MUSSELSHELL RIVER NEAR SHAWMUT, MONT.

This station was established August 12, 1902, by S. B. Robbins. It is located at Crawford's ranch, one-eighth mile west of the post-office at Shawmut, Mont., and 25 miles east of Harlowtown, Mont. It was established to determine the amount of water available for irrigation and storage. The gage is a vertical rod, graduated to feet and tenths with nails, and spiked to a cottonwood stump on the right bank of the river about 200 feet north of Crawford's bunk house. The gage is read once each day by Elmer E. Crawford. A cable will be installed, as there is no bridge from which to make discharge measurements. The channel is straight for 250 feet above and 300 feet below the station. The right bank is high and steep and will overflow at extreme high water. The left bank is low and sloping and will overflow at high water. There is one channel at all stages. At extreme high water the banks may overflow, so that the discharge can not be determined accurately, but this location is the best in this vicinity. Bench mark No. 1 is a 30-penny spike in an 18-inch cottonwood tree, below a blaze. This tree stands at the corral fence, 75 feet northeast of the gage rod. The elevation of the bench mark is 5.89 feet above the zero of the gage. Bench mark No. 2 is a 10-penny spike in a 6-inch cottonwood tree, below a blaze. This tree is 60 feet southeast of the gage rod. The elevation of the bench mark is 6.14 feet above the zero of the gage. The barometric elevation of this station is 3,900 feet above sea level.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurement of Musselshell River near Shawmut, Mont., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
November 8	L. R. Stockman	53.4	1.38	1.15	74.0

Mean daily gage height, in feet, of Musselshell River near Shawmut, Mont., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.10	.....	.....	1.37	2.88	2.90	1.30	1.00	0.30	0.65	1.00
2	1.10	.....	.....	1.37	2.78	3.60	1.30	1.00	1.00	.70	1.00
3	.....	.....	.....	1.37	2.68	3.40	1.50	.90	.80	.70	1.00
4	.....	.....	.....	1.87	2.88	3.10	1.50	.90	.60	.75	1.00
5	.....	.....	1.60	2.17	2.78	3.00	1.50	.80	.60	.75	1.00
6	.....	.....	.....	2.17	2.88	2.80	1.40	.80	.60	.80	1.00
7	.....	.....	.....	1.87	2.78	2.70	1.40	.80	.60	.95	1.00
8	.90	.....	.....	1.77	2.58	2.80	1.40	.70	.60	.95	1.00
9	.90	.....	.....	1.67	2.48	2.70	1.40	.70	.60	.95	1.00
10	1.10	.....	1.40	2.27	2.48	2.50	1.60	.70	.50	.95	1.00
11	1.00	.....	1.40	2.84	2.55	2.40	1.70	.60	.50	.95	.85
12	1.10	.....	1.40	2.94	2.55	2.40	1.50	.60	.60	.95	1.00
13	.90	.....	1.40	2.84	2.45	2.30	1.50	.60	.60	.95	.....
14	1.00	.....	1.40	3.14	2.35	2.20	1.50	.60	.60	.95	.....
15	1.00	.....	1.40	3.24	2.35	2.10	1.50	.60	.60	.95	.....
16	1.00	.....	1.40	3.24	2.25	2.00	1.50	.60	.60	1.00	.....
17	1.00	.....	1.40	3.44	2.35	2.00	1.50	.40	.60	1.00	.....
18	1.10	.....	1.30	2.34	2.35	1.90	1.50	.40	.60	1.00	.....
19	1.10	.....	1.30	2.34	2.25	1.90	1.40	.40	.60	1.00	.....
20	1.20	.....	1.20	2.54	2.55	1.90	1.40	.30	.65	1.00	.....
21	1.30	.....	1.30	2.61	2.92	1.80	1.30	.30	.65	1.00	.....
22	.....	.....	1.30	2.81	3.02	1.80	1.30	.30	.65	1.00	.....
23	.....	1.50	1.20	2.81	3.32	1.70	1.30	.30	.65	1.00	.....
24	.....	1.60	1.20	2.91	3.62	1.60	1.30	.30	.65	1.00	.....
25	.....	.....	1.20	2.71	3.92	1.80	1.30	.30	.65	1.00	.....
26	.....	.....	1.20	2.71	3.72	1.90	1.20	.30	.65	1.00	.....
27	.....	1.50	1.30	2.71	3.22	1.70	1.20	.30	.65	1.00	.....
28	.....	.....	1.20	2.91	2.72	1.60	1.10	.30	.65	1.00	.....
29	.....	.....	1.30	3.01	2.52	1.50	1.00	.30	.65	1.00	.....
30	.....	.....	1.30	3.21	2.52	1.40	1.00	.30	.65	1.00	.....
31	.....	.....	1.50	.....	2.62	.....	1.00	.30	.....	1.00	.....

[a] River frozen January 1 to 7, inclusive, and January 22 to March 9, inclusive.

LITTLE MUDDY RIVER NEAR WILLISTON, N. DAK.

This station was established February 4, 1904, by E. F. Chandler. It is located in Sec. 19, T. 155 N., R. 100 W., the gage in the SW. ¼, the cable in the NE. ¼, about 7 miles by road from Williston, N. Dak. A standard chain gage is attached to a timber projecting horizontally over the stream near the house of the observer, W. O. Hollar, who reads the gage once each day. The length of the chain from the end of the weight to the outer edge of the ring is 22.23 feet. Discharge

measurements are made by means of a cable and car. A barbed wire with galvanized iron tags 10 feet apart is stretched across the stream just above the cable. The initial point for soundings is a point 6 inches behind the top of the cable support at the right bank. The channel is straight for about 600 feet above and 1,700 feet below the station. The current is sluggish. Both banks are high, clean, and do not overflow. The bed of the stream is composed of silt and is fairly permanent. There is but one channel at all stages. The bench mark is a post driven to the surface of the ground under the projecting timber of the chain gage, and marked with a brass-headed nail in the top. Its elevation above the zero of the gage is 2.92 feet.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Little Muddy River near Williston, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 16	E. F. Chandler	115	674	1.31	5.40	885
May 2	do	104	520	.69	4.14	359
May 30	R. Richards	95	289	.21	2.74	61
June 7[a]	E. F. Chandler and E. C. Murphy.	42	30	1.33	2.92	40
July 12[a]	R. Richards	7	5.8	1.96	2.52	11.5
August 10[a]	do	7	5.1	1.66	2.50	8.4
September 13[a]	E. F. Chandler	7	5.0	1.82	2.47	9.

[a] By wading.

Mean daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1904.

Day.	Apr.[a]	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.9	2.7	2.6	2.4	2.4	2.5	2.6	2.6
2	.....	4.95	2.7	2.6	2.4	2.4	2.5	2.6	2.6
3	5.7	4.8	2.65	2.6	2.4	2.4	2.5	2.6	2.6
4	5.8	4.4	2.7	2.6	2.4	2.4	2.5	2.6	(b)
5	6.2	4.2	2.8	2.6	2.4	2.4	2.5	2.6	.....
6	6.6	4.05	2.9	2.6	2.4	2.4	2.5	2.6	.....
7	7.7	3.9	2.9	2.6	2.4	2.4	2.5	2.6	.....
8	7.6	3.6	2.8	2.6	2.4	2.4	2.5	2.6	.....
9	7.6	3.35	2.7	2.6	2.4	2.4	2.5	2.6	.....
10	8.2	3.25	2.7	2.6	2.5	2.4	2.5	2.6	.....
11	10.3	3.3	2.8	2.5	2.5	2.4	2.5	2.6	.....
12	8.4	3.35	3.05	2.5	2.5	2.4	2.5	2.6	.....
13	10.0	3.4	2.85	2.5	2.5	2.5	2.5	2.6	.....

[a] Gage heights April 3 to 15, inclusive, estimated.
[b] River frozen during January, February, March, and December

Mean daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1904—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
14	9.0	3.3	2.75	2.5	2.5	2.5	2.5	2.6	.....
15	8.4	3.2	2.7	2.5	2.5	2.5	2.5	2.6	.....
16	5.4	3.15	2.7	2.5	2.5	2.5	2.5	2.6	.....
17	5.25	3.05	2.7	2.5	2.5	2.5	2.5	2.6	.....
18	5.1	3.0	2.7	2.5	2.5	2.5	2.5	2.6	.....
19	5.2	2.9	2.65	2.5	2.4	2.5	2.5	2.6	.....
20	5.15	2.9	2.6	2.5	2.4	2.5	2.5	2.6	.....
21	5.0	2.9	2.6	2.5	2.4	2.5	2.5	2.6	.....
22	5.0	2.8	2.6	2.5	2.4	2.5	2.5	2.6	.....
23	4.8	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
24	4.65	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
25	4.5	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
26	4.6	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
27	4.95	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
28	5.35	2.8	2.6	2.5	2.5	2.5	2.5	2.6	.....
29	5.25	2.7	2.6	2.5	2.5	2.5	2.5	2.6	.....
30	5.1	2.7	2.6	2.5	2.5	2.5	2.6	2.6	.....
31	.....	2.7	.....	2.4	2.4	.....	2.6	.....	.....

Rating table for Little Muddy River near Williston, N. Dak., from February 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	6	3.40	137	4.30	423	5.20	794
2.50	10	3.50	162	4.40	461	5.30	839
2.60	16	3.60	189	4.50	500	5.40	885
2.70	23	3.70	218	4.60	539	5.50	932
2.80	32	3.80	249	4.70	579	5.60	980
2.90	43	3.90	281	4.80	620	5.70	1,030
3.00	57	4.00	315	4.90	662	5.80	1,082
3.10	74	4.10	350	5.00	705	5.90	1,135
3.20	93	4.20	386	5.10	749	6.00	1,189
3.30	114						

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly defined between gage heights 2.4 feet and 5.4 feet. This table has been extended beyond these limits. Discharges for gage heights above 6 feet have been estimated.

Estimated monthly discharge of Little Muddy River near Williston, N. Dak., for 1904.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April (3–30)	4,340	500	1,513	84,030	1.89	1.97
May	684	23	163	10,020	.204	.235
June	66	16	24.6	1,464	.031	.035
July	16	6	11.8	726	.015	.017
August	10	6	8.2	504	.010	.012
September	10	6	8.4	500	.010	.011
October	16	10	10.4	640	.013	.015
November	16	16	16.0	952	.020	.022
The period				98,840		

YELLOWSTONE RIVER NEAR LIVINGSTON, MONT.

This station was established May 2, 1897. It is located at Carter's bridge, 5 miles south of Livingston, Mont., at the mouth of the lower canyon. A vertical rod was first installed, but was replaced by a wire gage, which is located on the lower side of the east span. The length of the wire from the end of the weight to the marker was 21.76 feet. This gage in turn was replaced in April, 1904, by a standard chain gage having the same datum, but a chain length 20.73 feet. The gage is read once each day by W. O. Cowan. Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is marked on the guard rail, 2 feet east of the center of the northwest pier. The channel is straight for about 300 feet above and for 250 feet below the station. The right bank is low, and at high stages a part of the water escapes through a slough on that side and has to be measured separately. The left bank is high and rocky and will not overflow. The current velocity is swift, and at high water it is difficult to keep the meter submerged without the aid of a stay rope. On January 1, 1903, the gage and the datum were lowered 3 feet, increasing all subsequent readings by that amount. Bench mark No. 1 is the head of the 2-inch nut on the center pin at the foot of the end diagonal of the upstream truss at the east pier. Its elevation is 13.44 feet above the old and 17.60 feet above the new datum. Bench mark No. 2 is a white paint mark on the corner of the top of the shoe at the foot of the batter post on the east end of the upstream side of the bridge. The batter post is marked "B. M. 14.20, U. S. G. S." in white paint. It is also marked "17.20" in red paint. Its elevation is 14.20 feet above the old and 17.20 feet above the new gage datum.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Yellowstone River near Livingston, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 23	A. E. Place	190	642	3.44	2.88	2,206
May 16	W. B. Freeman	184	1,009	4.91	4.77	4,957
June 2	do	274	2,002	8.70	8.42	17,418
June 23	do	278	2,138	9.62	8.94	20,573
June 25	do	278	1,927	7.80	8.02	15,034
July 11	do	274	1,687	7.55	7.16	12,736
July 26	do	189	1,250	6.14	5.78	7,677
August 20	do	184	894	4.62	4.19	4,130
September 13	do	181	738	3.79	3.34	2,794
October 26	L. R. Stockman	171	577	3.30	2.54	1,904

Mean daily gage height, in feet, of Yellowstone River near Livingston, Mont., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	1.60	2.00	2.10	3.75	8.28	8.15	5.42	3.90	2.87	2.50	2.10
2	1.60	1.65	1.95	2.05	3.70	8.28	8.15	5.38	3.80	2.87	2.45	2.15
3	1.65	1.65	1.90	2.05	3.75	7.98	8.05	5.12	3.80	2.82	2.40	2.20
4	1.60	1.75	1.90	2.15	3.90	7.48	8.05	5.12	3.60	2.72	2.40	2.25
5	1.65	1.95	1.95	2.15	4.25	7.48	7.95	5.02	3.60	2.72	2.40	2.15
6	1.60	1.80	1.95	2.15	4.20	7.68	7.75	4.92	3.60	2.72	2.40	1.70
7	1.55	1.55	2.05	2.20	4.25	8.18	7.45	4.82	3.55	2.72	2.35	1.90
8	1.65	(a)	2.15	2.15	4.10	8.13	7.30	4.72	3.50	2.72	2.30	2.00
9	1.75	(a)	2.35	2.05	3.75	8.08	7.30	4.72	3.50	2.72	2.30	2.00
10	1.70	(a)	2.05	2.25	3.90	8.48	7.15	4.72	3.40	2.72	2.30	2.50
11	1.80	(a)	2.05	2.45	4.30	8.48	7.15	4.72	3.40	2.72	2.25	2.10
12	1.85	1.85	2.10	2.55	4.10	8.48	7.15	4.68	3.40	2.72	2.25	1.90
13	1.85	1.75	2.05	2.60	4.15	8.48	7.45	4.62	3.35	2.72	2.20	1.90
14	1.90	1.85	2.10	2.75	4.30	8.48	7.15	4.62	3.30	2.67	2.20	2.00
15	1.90	(a)	2.10	2.85	4.70	8.68	6.80	4.42	3.30	2.67	2.20	2.00
16	1.95	2.00	2.05	2.85	4.75	8.68	6.65	4.32	3.20	2.67	2.20	1.95
17	1.95	1.85	1.95	2.75	4.75	8.78	6.55	4.32	3.15	2.77	2.20	2.00
18	1.90	1.75	2.00	2.70	b5.25	8.88	6.35	4.32	3.15	2.77	2.20	2.00
19	1.85	1.55	2.10	2.75	6.20	8.88	6.25	4.32	3.15	2.67	2.20	2.00
20	1.80	1.75	2.15	3.05	6.80	8.88	6.25	4.22	3.10	2.67	2.20	2.00
21	1.65	1.85	2.10	3.05	7.80	8.73	6.20	4.12	3.10	2.67	2.20	2.00
22	1.55	1.90	1.80	2.95	8.20	8.78	6.15	4.12	3.10	2.62	2.20	2.00
23	1.60	1.95	1.80	2.85	8.20	8.88	6.05	4.08	3.05	2.62	2.15	1.95
24	1.65	1.90	1.80	2.90	8.90	8.78	6.10	3.92	3.00	2.57	2.15	1.80
25	(a)	1.90	2.05	2.80	8.20	7.98	5.95	3.92	3.00	2.57	2.15	1.70
26	1.95	2.00	1.95	2.90	7.20	7.78	5.85	3.82	3.00	2.52	2.10	1.70
27	1.75	1.95	2.05	3.20	6.70	7.78	5.75	3.82	3.00	2.60	2.10	1.80
28	1.85	1.95	2.15	3.65	7.00	7.78	5.75	3.82	3.00	2.60	2.10	1.80
29	1.85	2.00	2.15	3.90	7.60	7.98	5.75	3.92	3.00	2.50	2.20	1.70
30	(a)	.....	2.15	3.80	8.20	8.18	5.55	4.02	3.00	2.50	2.20	2.00
31	1.65	.....	2.15	.....	8.20	.....	5.45	4.02	.....	2.50	.....	2.10

a River frozen at gage. b River running through side channel May 18 to August 6.

Rating table for Yellowstone River near Livingston, Mont., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
1.30	900	2.60	1,970	3.90	3,615	6.40	9,645
1.40	950	2.70	2,070	4.00	3,785	6.60	10,305
1.50	1,010	2.80	2,170	4.20	4,125	6.80	10,980
1.60	1,080	2.90	2,270	4.40	4,465	7.00	11,660
1.70	1,160	3.00	2,380	4.60	4,820	7.20	12,400
1.80	1,250	3.10	2,490	4.80	5,220	7.40	13,190
1.90	1,340	3.20	2,600	5.00	5,700	7.60	13,990
2.00	1,430	3.30	2,720	5.20	6,195	7.80	14,810
2.10	1,520	3.40	2,850	5.40	6,695	8.00	15,700
2.20	1,610	3.50	2,980	5.60	7,210	8.50	18,050
2.30	1,700	3.60	3,125	5.80	7,760	9.00	20,400
2.40	1,790	3.70	3,280	6.00	8,350		
2.50	1,880	3.80	3,445	6.20	8,985		

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is well defined between gage heights 3 feet and 9 feet. The table has been extended beyond these limits. Above 8 feet the curve is a tangent, the difference being 470 per tenth.

Estimated monthly discharge of Yellowstone River near Livingston, Mont., for 1904.

[Drainage area, 3,580 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,385	1,045	1,211	74,462	0.338	0.390
February	1,430	1,045	1,256	72,246	.351	.378
March	1,745	1,250	1,460	89,772	.408	.470
April	3,615	1,475	2,102	125,078	.587	.655
May	19,930	3,280	8,446	519,324	2.359	2.720
June	19,930	13,590	17,291	1,028,886	4.830	5.389
July	16,405	6,820	11,069	680,607	3.092	3.565
August	6,695	3,445	4,604	283,089	1.286	1.483
September	3,615	2,380	2,749	163,577	.768	.857
October	2,220	1,880	2,030	124,820	.567	.654
November	1,880	1,520	1,653	98,360	.462	.515
December	1,880	900	1,388	85,345	.388	.447
The year	19,930	900	4,605	3,345,566	1.286	17.523

YELLOWSTONE RIVER NEAR BILLINGS, MONT.

This station was established May 29, 1904, by R. S. Stockton. It is located at the county wagon bridge, about 2 miles east of Billings, Mont., and 200 feet below the bridge of the Northern Pacific Railway. A standard chain gage is attached to the bridge, near the middle of the first span from the west bank. The length of the chain from the end of the weight to the marker is 27.95 feet. Marker is a copper-wire index. The gage is read twice each day by James Dickie. Discharge measurements are made from the lower side of the bridge. The bridge is well constructed of wood and has three spans resting on steel-jacketed concrete piers. The initial point for soundings is at the west end of the bridge. Each 10-foot point is marked on the bridge timbers. The channel is straight for about 200 feet above and 400 feet below the station, and the current is swift. The right bank is a low gravel bar which rises to above high water. Above the bridge is the headgate for a small ditch. The left bank is low, sandy, and overflows in extreme high water. The bed of the stream is composed of gravel, free from vegetation. There is but one channel at all stages, broken by two piers. The masonry piers of the railway bridge, 200 feet upstream; an island, 400 feet downstream; and the height of the bridge above the water, about 20 feet, affect the accuracy of measurements. Bench mark No. 1 is on the top of the third course of stones in the left abutment of the bridge of the Northern Pacific Railway. Its elevation is 18.99 feet above the zero of the gage. Bench mark No. 2 is the top of a nail on the end of the second bent from the west end of the wagon bridge, on the downstream end of the bent sill. Its elevation is 18.21 feet above the zero of the gage.

A river gage is also maintained by the Department of Agriculture at the second county bridge above, about 4 miles west of the Geological Survey station.

Observations were made at this station since the end of May, 1904, under the direction of C. C. Babb, district engineer.

Discharge measurements of Yellowstone River near Billings, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 10	R. S. Stockton	462	4,719	4.64	8.40	21,907
July 29	do	419	3,230	3.80	6.05	12,289
August 18	W. B. Freeman	332	2,542	3.53	4.33	8,963
September 16	do	320	2,069	2.46	2.90	5,086
September 27	R. S. Stockton	335	1,974	2.18	2.53	4,305
October 21	L. R. Stockman	.....	1,838	2.24	2.53	4,124

Mean daily gage height, in feet, of Yellowstone River near Billings, Mont., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.20	8.10	5.95	4.45	2.30	2.20	1.90
2	.....	9.00	9.05	5.15	4.10	2.30	2.10	1.90
3	.....	.....	9.15	5.05	3.75	2.30	2.10	1.90
4	.....	8.40	9.00	.....	3.65	2.30	2.10	(a)
5	.....	8.10	8.75	4.85	3.35	2.30	2.00	(a)
6	.....	8.05	8.60	4.70	3.35	2.30	2.00	(a)
7	.....	8.60	8.85	4.55	3.35	2.30	2.00	(a)
8	.....	8.00	8.80	4.50	3.35	2.40	2.00	(a)
9	.....	9.40	8.50	4.45	3.25	2.30	2.00	(a)
10	.....	9.60	8.50	4.45	3.25	2.30	2.00	(a)
11	.....	9.00	8.30	4.45	3.05	2.40	2.00	1.60
12	.....	8.10	8.20	4.60	3.05	2.40	2.10	1.60
13	.....	9.00	8.35	4.80	3.00	2.40	2.10	1.70
14	.....	9.10	8.20	4.70	2.95	2.40	2.20	1.70
15	.....	9.40	8.05	4.55	2.95	2.50	2.20	1.70
16	.....	9.60	7.70	4.35	2.85	2.70	2.20	1.70
17	.....	9.85	7.35	4.35	2.85	2.50	2.00	1.70
18	.....	10.00	6.85	4.40	2.75	2.50	2.00	1.70
19	.....	10.25	6.40	4.15	2.60	2.50	2.00	1.70
20	.....	10.60	6.35	4.10	2.55	2.40	2.00	1.70
21	.....	10.50	6.40	4.05	2.65	2.40	2.00	1.70
22	.....	10.30	6.40	4.00	2.65	2.30	2.00	1.70
23	.....	10.40	6.40	3.75	2.65	2.30	1.95	1.70
24	.....	10.05	6.55	3.65	2.75	2.30	1.90	1.60
25	.....	9.50	6.45	3.65	2.75	.....	1.90	1.60
26	.....	9.00	6.40	3.55	2.65	2.30	1.90	1.60
27	.....	8.30	6.10	3.55	2.55	2.30	1.90	1.60
28	.....	8.30	5.85	3.55	2.45	2.20	1.90	1.60
29	7.75	8.40	6.10	4.15	2.45	2.20	1.90	1.60
30	8.10	8.80	6.05	4.05	2.45	2.20	1.90	1.60
31	9.00	.....	6.05	4.55	.....	2.20	.....	1.60

a River frozen.

Rating table for Yellowstone River near Billings, Mont., from May 29 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	2,740	3.10	5,350	4.60	8,770	7.00	15,690
1.70	2,900	3.20	5,560	4.70	9,020	7.20	16,450
1.80	3,060	3.30	5,770	4.80	9,270	7.40	17,230
1.90	3,225	3.40	5,990	4.90	9,520	7.60	18,040
2.00	3,390	3.50	6,210	5.00	9,770	7.80	18,900
2.10	3,555	3.60	6,440	5.20	10,290	8.00	19,840
2.20	3,720	3.70	6,670	5.40	10,810	8.20	20,820
2.30	3,890	3.80	6,900	5.60	11,330	8.40	21,800
2.40	4,060	3.90	7,130	5.80	11,860	8.60	22,780
2.50	4,230	4.00	7,360	6.00	12,400	8.80	23,760
2.60	4,410	4.10	7,590	6.20	12,960	9.00	24,740
2.70	4,590	4.20	7,820	6.40	13,550	9.50	27,190
2.80	4,770	4.30	8,050	6.60	14,210	10.00	29,640
2.90	4,960	4.40	8,290	6.80	14,940	10.50	32,090
3.00	5,150	4.50	8,530				

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined between gage heights 2.5 feet and 8.4 feet. Beyond these limits the table is only approximate. Above gage height 8 feet the rating curve is a tangent, the difference being 490 per tenth.

Estimated monthly discharge of Yellowstone River near Billings, Mont., for 1904.

[Drainage area, 11,180 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
June	32,580	19,840	25,972	1,545,441	2.323	2.592
July	25,475	11,995	18,088	1,112,188	1.618	1.865
August	12,265	6,325	8,257	507,703	.738	.851
September	8,410	4,145	5,240	311,802	.469	.523
October	4,590	3,720	3,973	244,290	.355	.409
November	3,720	3,225	3,420	203,504	.306	.341
December	3,225	2,740	2,906	178,683	.260	.300
The period				4,103,611		

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, established in 1893 by the United States War Department, was transferred to the Department of Agriculture, where daily records of the gage are kept.

When a study of the lower Yellowstone Valley was begun in 1903 this station was taken up by the United States Geological Survey, whose records begin August 1, 1903. It is located at the steel highway bridge leading northward out of Glendive, about one-fourth mile from the post-office. The gage is of the wire type and is fastened to the upstream hand rail of the second span, about 200 feet from its right end. The graduations are marked upon the hand rail. The marker is an adjustable pointer near the handle. The distance from the marker to the bottom of the weight is 48.99 feet. This gage was destroyed October 24. One month later a standard chain gage, having the same datum as the old wire gage, was put in its place. The gage is read daily by H. A. Sample, of Glendive, Mont. The measurements are made from the downstream hand rail of the bridge, upon which the distances are painted. The initial point is over the southeast cement-filled iron pier at the right. The bridge spans the channel in four truss spans of about 300 feet each. The channel above is straight for about 500 feet and below for the same distance. The water, especially at high stages, is very swift. The right bank is high and of clay and gravel. Being riprapped for some distance, it is not subject to inundation. The left is a low bank, beyond which are sandy flats covered with trees and brush and extending to the hills, 1 mile distant. These are liable to become submerged. At low water an island becomes visible between the third and fourth spans from the right, and at flood stages water finds it way through a slough traversing the above-mentioned flats. The bed is of sand and clay and liable to shift with every flood. Old piling and cribwork, remains of a former bridge, obstruct the channel on the upstream side. Bench mark No. 1 is a point on the surface of the cement at the northwest corner of the girder on the pier under Station "O." Its elevation is 26.26 feet above gage datum and 2,060.6 feet above sea level. Bench mark No. 2 is the top of the west rail of the Northern Pacific track at the right end of the bridge. Its elevation is 30.19 feet above gage datum. A temporary bench mark is the center of the pulley of the old wire gage, which is fastened to the hand rail and is 41.96 feet above the gage zero. The elevation above sea level of the bench marks was determined from the Northern Pacific Railway elevation of the rail at Terry, Mont. This is 2,242 feet above sea level. The gage readings from 1897 to the establishment of the Geological Survey wire gage were referred to a "T" on the top of the southeast anchor bolt in the south caisson at the east end of the bridge. Its

elevation when established was 25.08 feet above gage datum. The gage heights up to April 8, 1899, were read from a wire gage. On this date the gage was carried away by ice and the gage heights during the remainder of 1899 were determined by measuring down from the bench mark on the anchor bolt. A new bridge was erected in 1901, and it is not known whether this bench mark was disturbed or not.

The observations at this station during 1904 have been made under the direction of C. C. Babb, district engineer.

Discharge measurements of Yellowstone River at Glendive, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 22	A. E. Place	649	3,617	2.96	2.44	10,718
May 17	W. B. Freeman	738	4,631	3.32	4.11	15,396
June 1	W. B. Freeman and E. C. Murphy.	760	7,260	5.78	7.42	41,982
June 24	W. B. Freeman	1,035	9,722	6.71	9.21	65,224
July 12	do	760	6,958	5.37	7.02	37,364
July 25	do	744	5,569	4.16	5.28	23,162
August 19	do	732	4,117	2.98	3.35	12,250
September 19	do	721	2,917	2.33	1.89	6,792
October 22	L. R. Stockman	727	2,787	2.32	1.64	6,474

Mean daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.10	4.60	5.20	11.90	3.40	7.40	7.00	5.10	2.85	1.50	.....	0.75
2	5.10	4.60	5.20	7.90	3.60	8.80	7.20	4.90	3.35	1.50	.....	1.15
3	5.00	4.60	5.20	6.70	3.60	8.50	7.70	4.70	3.95	1.50	.....	.95
4	5.00	4.60	5.20	6.00	3.60	9.60	8.20	4.50	3.55	1.40	.....	.85
5	5.00	4.60	5.90	5.50	3.70	8.40	8.20	4.40	3.15	1.30	.....	4.45
6	5.00	4.60	6.50	4.80	3.80	8.40	8.20	4.20	2.95	1.30	.....	[b]6.05
7	5.10	4.60	6.60	4.00	4.40	7.90	7.50	4.00	2.85	1.30	.....	5.75
8	5.10	4.60	6.80	3.40	4.90	7.30	7.50	4.00	2.75	1.30	.....	5.65
9	5.10	4.60	6.80	3.00	4.90	7.30	7.20	3.90	2.65	1.30	.....	5.65
10	5.10	4.60	7.00	2.90	4.90	7.80	7.10	3.80	2.55	1.30	.....	5.55
11	5.10	4.60	9.90	2.70	4.90	7.80	7.30	3.70	2.45	1.30	.....	5.55
12	5.10	4.60	10.60	2.20	4.50	8.10	7.00	3.60	2.45	1.30	.....	5.55
13	5.10	4.60	10.00	2.20	4.30	8.50	7.00	3.50	2.35	1.30	.....	5.45
14	5.10	4.60	8.90	2.20	4.30	8.60	6.90	3.50	2.15	1.30	.....	5.35
15	5.10	4.60	8.40	2.50	4.20	8.20	6.90	3.70	2.05	1.30	.....	5.15
16	5.10	4.60	8.00	2.50	4.20	8.10	7.00	3.70	2.05	1.30	.....	5.10
17	5.10	4.60	7.70	2.60	4.10	8.20	6.80	3.50	1.95	1.40	.....	5.10
18	5.10	4.60	7.70	2.80	4.30	8.40	6.50	3.50	1.95	1.50	.....	5.10

[a] River frozen from January 1 to March 31, inclusive, gage heights to top of ice. Thickness of ice from January 1 to 17, inclusive, 13 inches; from January 18 to 26, inclusive, 14 inches; from January 27 to March 31, inclusive, 20 inches.

[b] River frozen; readings to top of ice for remainder of month.

Mean daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
19	5.10	4.60	7.50	2.90	4.40	8.80	6.30	3.40	1.85	2.10	.....	5.10
20	5.10	4.60	7.50	2.60	4.50	9.20	6.00	3.30	1.85	1.80	.....	4.90
21	5.10	4.60	7.20	2.60	4.70	9.30	5.70	3.30	1.85	1.80	.....	5.00
22	5.10	4.60	7.20	2.60	6.00	9.50	5.50	3.30	1.75	1.70	.....	5.00
23	5.10	4.60	7.00	2.70	7.10	10.20	5.40	3.30	1.75	1.60	.....	5.00
24	5.10	4.60	7.00	3.00	7.90	9.20	5.30	3.20	1.65	(a)	.....	4.60
25	5.10	4.60	7.00	3.50	8.80	9.20	5.30	3.20	1.65	.....	.....	5.10
26	5.10	4.60	7.00	4.50	9.00	9.10	5.30	3.10	1.65	.....	.....	5.20
27	5.10	4.60	7.00	3.70	9.30	9.10	5.40	2.90	1.65	.....	.....	4.50
28	5.10	4.80	7.00	3.50	8.90	8.00	5.40	2.80	1.55	.....	.....	4.40
29	5.00	5.00	5.50	3.10	7.90	7.50	5.20	2.60	1.55	.....	0.65	4.30
30	4.90	.....	5.90	2.90	7.50	7.20	5.20	2.60	1.45	.....	.65	4.30
31	4.80	.....	8.40	.....	7.20	.....	5.20	2.60	.....	.....	.....	4.40

a Gage broken. Reestablished November 29.

Rating table for Yellowstone River at Glendive, Mont., from April 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	5,625	2.60	9,020	3.90	14,450	6.40	31,090
1.30	5,750	2.70	9,380	4.00	14,960	6.60	32,930
1.40	5,900	2.80	9,760	4.20	16,010	6.80	34,850
1.50	6,075	2.90	10,150	4.40	17,100	7.00	36,900
1.60	6,275	3.00	10,550	4.60	18,230	7.20	39,150
1.70	6,500	3.10	10,950	4.80	19,400	7.40	41,580
1.80	6,750	3.20	11,360	5.00	20,610	7.60	44,100
1.90	7,000	3.30	11,770	5.20	21,890	7.80	46,700
2.00	7,250	3.40	12,190	5.40	23,220	8.00	49,300
2.10	7,510	3.50	12,610	5.60	24,600	8.50	55,800
2.20	7,780	3.60	13,040	5.80	26,070	9.00	62,300
2.30	8,060	3.70	13,490	6.00	27,650	9.50	68,800
2.40	8,360	3.80	13,960	6.20	29,330	10.00	75,300
2.50	8,680						

The above table is applicable on.y for open-channel conditions. It is based upon 12 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.4 feet and 9.2 feet. Above gage height 8.0 feet the rating curve is a tangent, the difference being 1,300 per tenth.

Estimated monthly discharge of Yellowstone River at Glendive, Mont., for 1903 and 1904.

[Drainage area, 66,090 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
March 16 to 31, inclusive	20,610	15,480	17,550	556,958	0.266	0.158
April	39,150	4,600	6,208	369,343	.094	.105
May	22,550	4,700	10,775	664,066	.163	.188
June	62,300	10,550	40,594	2,415,629	.614	.685
July	61,000	16,550	28,089	1,726,818	.425	.490
August	30,200	7,780	14,012	861,564	.212	.244
September	10,150	6,075	7,737	460,384	.117	.130
October	7,510	5,900	6,860	421,805	.104	.120
November 1 to 15, inclusive	5,900	5,750	[a] 5,750	339,471	.087	.097
December	.....	.....	[a] 5,700	350,479	.086	.099
The period	.....	.....	.....	8,166,517	.....	.....
1904.						
January	.....	.....	[a] 5,700	350,479	.086	.099
February	.....	.....	[a] 5,700	327,868	.086	.093
March	.....	.....	[a] 5,700	350,479	.086	.099
April 2 to 30, inclusive[b]	48,000	7,780	[b] 13,936	829,250	.211	.235
May	66,200	12,190	27,002	1,660,288	.409	.472
June	77,900	39,150	54,882	3,265,706	.830	.926
July	51,900	21,890	33,500	2,059,835	.507	.584
August	21,240	9,020	12,698	797,371	.196	.226
September	14,705	5,985	8,273	492,278	.125	.139
October 1 to 23, inclusive	7,510	5,750	.....	.....	.....	.....
December 1 to 5[c]	.....	.....	7,710	76,463	.117	.022
The period	.....	.....	.....	10,210,017	.....	.....

[a] Estimated by C. C. Babb.
[b] Mean for 29 days taken as mean for the month.
[c] River frozen December 6 to 31.

PRYOR CREEK AT HUNTLEY, MONT.

This station was established August 6, 1904, by R. S. Stockton. It is located at Huntley, 13 miles from Billings, Mont. A plain rod gage, graduated to feet and tenths, is placed vertically at the right bank, about 200 feet south of the Northern Pacific Railway station. It is read twice

each day by J. W. Day. Measurements at present are made by wading at a point 50 yards above the gage. Bench mark No. 1 is the top of rail of Northern Pacific Railway Company's track in front of the operator's window. Its elevation is 14.517 feet above the zero of the gage. Bench mark No. 2 is a nail in a pile at the foot of large tree on east side of the creek opposite the station agent's house and post-office. Its elevation is 11.462 feet above the zero of the gage. Bench mark No. 3 is a spike driven into the root of a large tree 100 feet southwest of the water-tank and 150 feet north of the section house. The tree is 40 feet east of the track. The elevation of bench mark No. 3 is 12.787 feet above the zero of the gage. The zero of the gage is 3,012.483 feet above sea level.

Observations at the station since August, 1904, were made under the direction of C. C. Babb, district engineer.

Discharge measurements of Pryor Creek at Huntley, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
August 6[a]	R. S. Stockton	.....	6	1.00	1.00	6
September 17	W. B. Freeman	18	10	1.40	1.25	14

[a] Float measurement.

Mean daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.25	1.25	1.45	1.90	17	1.00	1.30	1.40	1.70	1.55
2	.....	1.30	1.30	1.50	1.85	18	.....	1.30	1.40	1.60	1.45
3	.....	1.30	1.30	1.55	1.80	19	1.05	1.30	1.40	1.55	1.60
4	.....	1.25	1.30	1.65	1.85	20	1.08	1.30	1.40	1.55	1.55
5	.....	1.20	1.40	1.55	1.75	21	1.10	1.30	1.50	1.55	1.55
6	.....	1.20	1.40	1.60	1.65	22	1.10	1.30	1.50	1.60	1.55
7	1.00	1.20	1.40	1.45	1.60	23	1.10	1.30	1.50	1.65	1.45
8	1.00	1.20	1.40	1.50	1.65	24	1.15	1.30	1.60	1.55	1.55
9	1.00	1.20	1.40	1.55	1.55	25	1.20	1.30	1.45	1.50	1.60
10	1.00	1.20	1.40	1.45	1.80	26	1.25	1.30	1.55	1.60	1.65
11	1.00	1.20	1.40	1.50	1.65	27	1.20	1.25	1.45	1.50	1.55
12	1.18	1.20	1.45	1.45	1.60	28	1.20	1.30	1.55	1.55	1.65
13	1.10	1.20	1.45	1.50	1.55	29	1.20	1.30	1.55	1.65	1.60
14	1.08	1.20	1.50	1.45	1.50	30	1.10	1.25	1.50	1.95	1.60
15	1.05	1.30	1.50	1.30	1.50	31	1.15	.....	1.55	.....	1.50
16	1.05	1.30	1.40	1.70	1.45						

BIGHORN RIVER NEAR THERMOPOLIS, WYO.

This station was established on May 28, 1900, by A. J. Parshall. It was located about a half mile northeast of Thermopolis, at the ferry crossing the river. The gage used during 1900 was a horizontal rod

extending out over the water and fastened to posts firmly set in the ground, with the usual wire attachments. The bench mark was the head of a nail driven in a stake set in the ground 1 foot south of the post to which the gage rod was fastened, 2.58 feet below the gage frame. Its elevation was 6.50 feet above gage datum. It has been destroyed.

In 1901 a new gage with relative heights, the same as that in use in 1900, was painted on the lower center pier of the recently constructed iron bridge, which is located 400 or 500 feet upstream from the former station. In March, 1903, a new gage, serving as a bench mark, and for the observer's use at times of high water, was painted on the lower pier of the bridge on the right bank of the river. This gage is reached by the water only when it is at a height of 3 feet above datum. It will enable the observer to read heights of high water more accurately than can be done on the gage, which is in the center of the stream and is exposed to the force of the current, causing a rise and fall of several inches on the gage. The channel is straight above and below the station. Both banks are high and not subject to overflow. The bed of the stream is composed of rock and gravel. It shifts very little from year to year. Measurements, which were formerly made from a ferryboat, are now made from the bridge. The gage is read daily by V. S. Grout.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Bighorn River near Thermopolis, Wyo.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec. feet.*
March 25	A. J. Parshall	94	198	1.46	0.41	290
June 19	V. S. Grout	262	1,944	6.66	7.25	12,940
June 22	do	268	2,115	6.73	7.90	14,240
July 11	A. J. Parshall	261	1,247	5.71	4.60	7,117
July 12	do	262	1,270	5.88	4.70	7,467
July 17	V. S. Grout	251	1,088	5.63	4.00	6,130
July 28	do	244	984	5.09	3.50	5,008
August 3	do	244	807	4.90	3.00	3,941
August 11	do	244	681	4.23	2.50	2,878
August 26	do	225	548	3.80	2.00	2,084
November 24	A. J. Parshall	166	306	1.43	.70	438

Mean daily gage height, in feet, of Bighorn River near Thermopolis, Wyo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.4	1.7	5.1	5.05	3.05	2.45	1.1
2	.4	1.6	5.5	5.35	3.05	2.1	1.0
3	.4	1.5	6.0	5.1	3.00	1.95	1.0
4	.3	1.85	5.75	4.95	2.85	1.9	1.1
5	.25	1.9	5.55	5.25	2.75	2.0	1.15
6	.35	1.75	4.45	5.65	2.75	1.95	1.2
7	.5	1.95	4.9	5.3	2.7	1.85	1.1
8	.6	2.0	5.55	4.9	2.65	1.7	1.1
9	.7	1.95	6.05	4.65	2.6	1.7	1.2
10	.7	2.05	6.3	4.5	2.6	1.6	1.2
11	.65	1.85	6.0	4.6	2.5	1.5	1.2
12	.6	1.7	5.65	4.65	2.45	1.5	1.35
13	.85	1.85	5.5	4.65	2.4	1.5	1.45
14	1.05	2.0	5.6	4.6	2.45	1.5	1.35
15	1.25	2.05	5.8	4.65	2.55	1.4	1.4
16	1.4	2.25	6.2	4.2	2.55	1.4	1.5
17	1.55	2.45	6.8	4.1	2.45	1.4	1.35
18	1.4	2.75	7.25	4.05	2.55	1.4	1.3
19	1.3	3.15	7.15	3.95	2.7	1.5	1.2
20	1.3	3.5	7.3	3.75	2.7	1.4	1.2
21	1.4	4.9	7.55	4.4	2.55	1.4	1.1
22	1.5	6.8	7.8	3.85	2.35	1.3	1.1
23	1.4	7.25	7.85	3.75	2.2	1.3	1.1
24	1.3	7.2	7.75	3.75	2.2	1.3	1.1
25	1.2	7.05	6.8	4.1	2.1	1.2	1.0
26	1.3	7.0	5.85	4.05	2.05	1.2	1.0
27	1.4	5.6	5.7	3.85	1.85	1.2	.9
28	1.45	5.15	5.85	3.4	2.05	1.2	.9
29	1.55	4.7	5.4	3.1	2.25	1.2	.9
30	1.65	4.55	4.6	3.0	2.5	1.1	.8
31	.....	4.75	.....	3.05	2.7	.....	.8

Rating table for Bighorn River near Thermopolis, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	150	1.60	1,530	3.00	3,820	4.80	7,530
.30	210	1.70	1,660	3.10	4,020	5.00	7,950
.40	280	1.80	1,800	3.20	4,220	5.20	8,380
.50	350	1.90	1,940	3.30	4,420	5.40	8,810
.60	430	2.00	2,080	3.40	4,620	5.60	9,240
.70	520	2.10	2,230	3.50	4,820	5.80	9,670
.80	620	2.20	2,390	3.60	5,020	6.00	10,100
.90	720	2.30	2,550	3.70	5,220	6.20	10,530
1.00	820	2.40	2,720	3.80	5,430	6.40	10,960
1.10	930	2.50	2,890	3.90	5,640	6.60	11,390
1.20	1,040	2.60	3,070	4.00	5,850	6.80	11,820
1.30	1,160	2.70	3,250	4.20	6,270	7.00	12,250
1.40	1,280	2.80	3,440	4.40	6,690	7.50	13,350
1.50	1,400	2.90	3,630	4.60	7,110	8.00	14,500

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is well defined.

Estimated monthly discharge of Bighorn River near Thermopolis, Wyo., for 1904.

[Drainage area, 8,184 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,595	180	873	51,950	0.107	0.119
May	12,800	1,400	4,984	306,500	.609	.702
June	14,160	6,795	10,370	617,100	1.27	1.42
July	9,347	3,820	6,551	402,800	.800	.922
August	3,920	1,870	2,946	181,100	.360	.415
September	2,805	930	1,470	87,470	.180	.201
October	1,400	620	974	59,890	.119	.137
The period				1,707,000		

BIGHORN RIVER AT FORT CUSTER, MONT.

This station was established June 16, 1904, by R. S. Stockton. It is located at the bridge of the Burlington and Missouri Railroad, about one-half mile above the junction of the Bighorn and Little Bighorn rivers. The nearest post-office is at Crow Agency, Mont., 11 miles distant; and the nearest town is Billings, Mont., 60 miles distant. A standard chain gage is fastened near the middle of the first span from the east bank. The length of the chain from the end of the weight to the marker is 31.71 feet. The gage is read twice each day by O. D. Hogue. Discharge measurements are made from the upper side of the three-span bridge to which the gage is attached. The initial point for soundings is at the east abutment of the bridge. Each 10-foot point is marked upon the bridge timbers. The channel is straight for about 400 feet above and 300 feet below the station, and the current is swift. The right bank is high, and can not be overflowed. The left bank is low, and is subject to overflow in extreme high water. The bed of the stream is composed of gravel, and is free from vegetation. There is but one channel at all ordinary stages, broken by two piers. Bench mark No. 1 is on the top of the east concrete abutment at the south end, on mark XXXIII. Its elevation is 14.90 feet above the zero of the gage. Bench mark No. 2 is on the top of first concrete pier west of the east abutment on the south end of the pier, on mark XXXVI. Its elevation is 14.85 feet above the zero of the gage. Bench mark No. 3 is on the top of the south end of the west concrete abutment, on mark XXXIV. Its elevation is 14.88 feet above the zero of the gage. The gage zero is approximately 2,879.10 feet above sea level.

The observations at this station since its establishment were made under the direction of C. C. Babb, district engineer.

Discharge measurements of Bighorn River at Fort Custer, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 16	R. S. Stockton	438	2,655	3.91	9.00	10,379
July 27	do	438	2,357	3.76	8.30	8,867
September 17	W. B. Freeman	427	1,376	1.50	6.00	2,069
October 1	R. S. Stockton	426	1,295	1.25	5.69	1,615
October 24	L. R. Stockman	418	1,310	1.28	5.65	1,673

Mean daily gage height, in feet, of Bighorn River at Fort Custer, Mont., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.47	7.82	6.70	5.70	5.70	5.65
2	.....	9.47	7.70	6.60	5.70	5.70	5.65
3	.....	9.35	7.58	6.52	5.70	5.70	5.65
4	.....	9.75	7.45	6.50	5.65	5.70	5.65
5	.....	9.45	7.38	6.48	5.65	5.60	5.65
6	.....	9.40	7.28	6.40	5.65	5.60	5.70
7	.....	9.30	7.15	6.40	5.65	5.60	5.70
8	.....	9.45	7.13	6.38	5.65	5.60	5.70
9	.....	9.35	7.03	6.30	5.65	5.60	5.70
10	.....	9.22	6.97	6.22	5.65	5.60	5.70
11	.....	9.10	6.95	6.10	5.65	5.50	5.70
12	.....	9.40	6.87	6.08	5.65	5.50	5.70
13	.....	9.37	6.83	6.00	5.70	5.50	5.70
14	.....	9.25	6.80	5.92	5.75	5.50	5.70
15	.....	9.07	6.85	6.02	5.75	5.50	5.70
16	10.05	8.92	6.83	6.00	5.80	5.50	5.70
17	10.10	8.90	6.75	6.00	5.80	5.50	5.70
18	10.37	8.70	6.75	6.00	5.80	5.60	5.70
19	10.35	8.50	6.75	5.95	5.80	5.60	5.70
20	10.55	8.40	6.13	5.92	5.80	5.65	5.70
21	10.62	8.25	7.05	5.90	5.75	5.65	5.70
22	10.57	8.05	6.97	5.90	5.75	5.65	5.70
23	10.65	8.45	6.95	5.85	5.75	5.65	5.70
24	10.69	8.65	6.80	5.80	5.70	5.65	5.70
25	10.30	8.40	6.60	5.75	5.80	5.65	5.70
26	10.10	7.95	6.55	5.75	5.75	5.65	5.70
27	9.70	8.15	6.45	5.75	5.75	5.65	5.70
28	9.40	8.25	6.40	5.70	5.75	5.65	5.70
29	9.20	8.20	6.40	5.70	5.70	5.65	5.70
30	9.25	8.10	6.57	5.70	5.70	5.65	5.70
31	.....	8.02	6.47	.....	5.70	.....	5.70

SHOSHONE RIVER NEAR CODY, WYO.

This station was established April 26, 1902, by A. J. Parshall. It is located at the wagon bridge 1 mile northwest of Cody, Wyo. The gage is a plain staff graduated to half tenths and is fastened to the bridge from which discharge measurements are made. The initial point for soundings is on the left bank. The channel is straight both above and below the station. The current is swift. The right bank is low and subject to overflow. The left bank is high and does not overflow. The bed of the stream is gravel and rock. The bench mark is a bolt in the bridge sleeper 1.15 feet above the 12-foot mark on the gage. It is indicated by a cross. The observer, W. J. Kissick, reads the gage twice daily.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Shoshone River near Cody, Wyo., 1902–1904.

Date.	Hydrographer.	Width.	Area of sections.	Mean velocity.	Gage height.	Discharge.
1902.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	A. J. Parshall		279	1.92	2.40	538
June 7	do		658	6.61	4.80	4,352
July 17	do		579	4.86	4.10	2,812
July 31	do		527	3.87	3.65	2,039
December 8	do		231	1.32	2.00	270
1903.						
March 20	A. J. Parshall		219	1.10	1.95	263
April 21	do		318	1.95	2.41	633
April 25	do		427	3.18	3.00	1,399
May 19	do		405	3.09	3.20	1,374
May 20	do		421	2.89	3.00	1,263
June 6	J. Ahern		698	3.76	4.70	2,624
June 11	do		865	6.35	5.25	5,502
June 16	A. J. Parshall		903	8.20	5.70	7,297
June 17	do		1,113	8.15	6.10	8,885
June 18	do		993	9.89	6.20	8,840
June 24	do		665	6.34	5.10	4,212
July 14	do		680	5.53	4.70	3,829
July 15	do		630	5.24	4.50	3,299
July 25	do				4.25	3,087
October 31	J. Ahern		337	1.33	2.20	450
1904.						
March 29	A. J. Parshall	97	238	1.06	1.90	253
April 30	W. E. Young	148	564	2.72	3.40	1,536
May 22	J. Ahern	178	786	7.89	5.50	6,200
June 17	do	196	880	7.19	6.10	6,330
June 20	do	206	1,122	8.12	6.45	9,116
August 27	do	128	413	2.87	3.15	1,186
September 9	A. J. Parshall	128	376	2.35	2.78	885
October 8	J. Ahern	110	268	1.54	2.20	413
December 22	do		249	1.29	1.90	321

Mean daily gage height, in feet, of Shoshone River near Cody, Wyo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.0	2.2	2.0	3.5	5.65	5.9	4.0	3.0	2.2	2.0	1.5
2	1.9	1.9	2.1	2.0	3.3	4.9	5.9	4.0	3.0	2.0	2.0	1.5
3	2.0	1.9	2.0	2.0	3.8	4.9	5.8	4.0	2.9	1.9	1.9	1.6
4	1.5	2.0	2.2	2.1	3.8	4.95	5.7	3.9	2.9	1.8	1.9	1.6
5	1.4	2.0	2.1	2.1	3.7	4.95	5.8	3.8	3.0	1.9	1.9	1.5
6	1.3	1.9	2.0	2.0	3.8	4.9	5.7	3.8	2.9	1.8	1.8	1.5
7	1.4	1.9	2.1	2.2	3.7	4.9	5.7	3.8	3.0	1.7	1.8	1.5
8	1.2	2.0	2.1	2.1	3.7	5.0	5.9	3.9	3.0	1.9	1.7	1.5
9	1.4	2.0	2.2	2.0	3.9	5.2	6.0	3.9	2.9	2.0	1.8	1.4
10	1.5	1.9	2.1	2.2	3.8	5.8	6.0	3.8	2.8	1.8	1.7	1.4
11	1.5	1.9	2.1	3.0	3.8	5.25	5.9	4.0	2.8	1.8	1.7	1.4
12	2.0	2.0	2.0	3.1	3.9	5.5	5.8	3.9	2.7	1.8	1.8	1.4
13	1.7	1.9	2.2	3.2	4.0	5.7	6.0	3.9	2.6	1.9	1.8	1.4
14	1.8	2.0	2.1	4.0	3.9	5.8	6.0	3.8	2.6	1.9	1.8	1.3
15	1.5	2.1	2.0	3.9	4.1	5.8	5.9	3.7	2.6	1.7	1.8	1.3
16	1.4	2.0	2.0	3.5	4.0	5.8	5.9	3.8	2.5	1.7	1.7	1.3
17	1.3	2.0	2.1	3.0	4.0	5.8	5.9	3.8	2.5	1.8	1.8	1.2
18	1.9	1.9	2.0	3.0	4.2	6.9	6.0	3.9	2.5	1.8	1.8	1.1
19	2.0	2.0	2.0	3.0	5.0	7.0	5.9	4.0	2.5	1.7	1.9	1.0
20	1.7	2.0	2.0	2.9	5.2	7.0	5.8	3.9	2.4	1.7	1.9	1.0
21	1.8	1.9	2.1	3.0	5.5	6.85	5.7	3.8	2.4	1.8	1.8	1.0
22	1.6	2.0	2.1	3.1	5.5	6.8	5.5	3.7	2.4	1.8	1.7	1.0
23	1.7	2.1	2.0	3.0	6.0	6.3	5.0	3.7	2.3	1.8	1.7	.9
24	1.9	2.1	2.1	2.9	6.0	6.0	4.9	3.8	2.4	1.9	1.7	.9
25	2.0	2.1	2.1	3.0	5.8	5.3	4.8	3.7	2.4	1.9	1.7	.9
26	1.9	2.2	2.0	3.9	5.1	5.25	4.8	3.5	2.3	1.9	1.6	.9
27	1.8	2.2	2.1	4.0	5.0	5.4	4.7	3.0	2.2	1.8	1.6	.9
28	1.9	2.2	2.1	3.9	5.1	5.35	4.7	3.0	2.2	1.8	1.6	.8
29	2.0	2.0	2.0	3.8	5.1	5.35	4.5	3.0	2.1	2.0	1.6	.8
30	2.0	.....	2.1	3.7	5.0	5.55	4.3	3.0	2.0	1.9	1.5	.9
31	2.0	.....	2.2	.....	5.3	.....	4.0	3.0	.....	1.9	.....	1.0

Rating table for Shoshone River near Cody, Wyo., from April 26, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	200	2.90	1,020	4.00	2,440	5.20	5,370
1.90	245	3.00	1,120	4.10	2,610	5.40	6,070
2.00	295	3.10	1,225	4.20	2,800	5.60	6,810
2.10	355	3.20	1,335	4.30	3,000	5.80	7,550
2.20	425	3.30	1,450	4.40	3,210	6.00	8,290
2.30	500	3.40	1,575	4.50	3,420	6.20	9,030
2.40	575	3.50	1,710	4.60	3,650	6.40	9,770
2.50	655	3.60	1,850	4.70	3,900	6.60	10,510
2.60	740	3.70	1,990	4.80	4,170	6.80	11,250
2.70	830	3.80	2,130	4.90	4,440	7.00	11,990
2.80	925	3.90	2,280	5.00	4,730		

The preceding table is applicable only for open-channel conditions. It is based upon 28 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.9 feet and 6.2 feet. The table has been extended beyond these limits, and is only approximate below gage height 1.90 feet. Above gage height 5.4 feet the rating curve is a tangent, the difference being 370 per tenth.

NOTE.—The preceding table supersedes the 1903 table below gage height 2 feet and is the same as the 1903 table above gage height 2 feet.

Estimated monthly discharge of Shoshone River near Cody, Wyo., 1902–1904, superseding monthly estimates previously published.

[Drainage area, 1,480 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1902.						
May	7,365	655	2,698	165,900	1.82	2.10
June	10,510	3,420	5,654	336,400	3.82	4.26
July	3,775	2,440	2,779	170,900	1.88	2.17
August	2,440	655	1,343	82,580	.907	1.05
September	655	655	655	38,980	.443	.494
October	655	655	655	40,270	.443	.510
The period				835,000		
1903.						
January	390	270	303	18,630	.205	.236
February	295	245	283	15,720	.191	.199
March	925	223	333	20,480	.225	.259
April	2,360	295	847	50,400	.572	.638
May	2,900	878	1,558	95,800	1.05	1.21
June	10,140	3,420	6,819	405,800	4.61	5.14
July	6,070	2,060	3,562	219,000	2.41	2.78
August	2,280	575	1,566	96,290	1.06	1.22
September	355	98	235	13,980	.159	.177
October	1,070	295	577	35,480	.390	.450
November	878	270	499	29,690	.337	.376
December	830	120	441	27,120	.298	.344
The year	10,140	98	1,419	1,028,000	.959	13.03
1904.						
January	295	80	192	11,810	.130	.150
February	425	245	301	17,310	.203	.219
March	425	295	345	21,210	.233	.269
April	2,440	295	1,154	68,670	.780	.870
May	8,290	1,450	3,766	231,600	2.54	2.93
June	11,990	4,440	7,087	421,700	4.79	5.34
July	8,290	2,440	6,592	405,300	4.45	5.13
August	2,440	1,120	2,019	124,100	1.36	1.57

Estimated monthly discharge of Shoshone River near Cody, Wyo., 1902–1904, superseding monthly estimates previously published—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
September	1,120	295	752	44,750	0.508	0.567
October	425	165	225	13,830	.152	.175
November	295	120	194	11,540	.131	.146
December	140	40	85	5,226	.057	.066
The year	11,990	40	1,893	1,377,000	1.28	17.44

CLEAR CREEK AT BUFFALO, WYO.

This station was established October 24, 1902, by Jeremiah Ahern. It is located at the highway bridge in the town of Buffalo, Johnson County, Wyo. The gage is a plain staff graduated to feet and tenths, spiked to the pier at the northwest end of the bridge. The initial point for soundings is on the left bank. Measurements are made from the bridge. The channel is straight both above and below the station. Both banks are high and rocky. The bed of the stream is also rocky. The gage is read daily by P. A. Gatchell. The bench mark is U. S. G. S. B. M. at the court-house, marked "SHER 4635." Its elevation is 4,635.033 feet above sea level. The elevation of the gage as determined from this bench mark is 4,605.766 feet.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Clear Creek at Buffalo, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 9[a]	A. J. Parshall	37	71	2.96	1.80	210
May 10[a]	do	38	79	3.33	2.00	263
May 19[a]	do	39	82	3.29	2.00	270
May 20[a]	do	40	115	5.76	3.05	663
May 21[a]	do	40	96	4.71	2.50	452
May 22[a]	do	40	109	5.21	2.80	568
June 11[a]	do	40	109	5.18	2.80	565
June 12[a]	do	40	89	3.64	2.20	324
July 7[a]	do	37	66	2.11	1.65	139
July 17[a]	do	36	55	1.64	1.50	91
September 11[b]	do	16	14	.86	.70	12
October 14[a]	do	25	34	.74	.95	24

[a] Foot bridge 300 yards above station. [b] Wading one-third mile above foot bridge.

Mean daily gage height, in feet, of Clear Creek at Buffalo, Wyo., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	1.2	1.3	1.2	0.8	1.7	2.9	1.8	1.3	0.8	0.7	0.7	0.75
2	1.2	1.2	1.3	.8	1.9	2.65	2.75	1.3	.8	.7	.7	.75
3	1.3	1.2	1.4	.8	3.0	2.3	2.55	1.2	.8	.7	.7	.75
4	1.3	1.3	1.2	.8	2.5	2.0	2.0	1.2	.8	.7	.7	.75
5	1.4	1.2	1.2	.8	2.5	2.2	2.0	1.2	.8	.7	.7	.75
6	1.5	1.2	1.2	.8	2.3	2.3	2.0	1.2	.8	.75	.7	.75
7	1.6	1.2	1.1	.8	2.1	2.55	1.9	1.1	.75	.7	.7	.75
8	1.4	1.1	1.0	.8	2.0	3.15	1.8	1.0	.75	.7	.7	.75
9	1.3	1.0	1.0	.8	1.9	2.65	1.8	1.0	.75	.7	.7	.75
10	1.2	1.0	1.0	.8	1.9	2.50	1.8	.9	.75	.75	.7	.75
11	1.2	1.1	1.0	.8	1.9	3.0	1.8	.95	.75	.75	.7	.75
12	1.2	1.1	1.0	1.0	1.9	2.5	1.8	.8	.75	.8	.7	.75
13	1.1	1.1	1.0	1.3	1.9	2.35	1.8	.75	.75	.85	.7	.8
14	1.2	1.1	.9	1.2	1.9	2.55	1.75	.75	.75	.95	.7	.8
15	1.2	1.1	.8	1.1	1.9	2.65	1.7	.75	.7	.95	.7	.8
16	1.2	1.2	.7	1.0	2.0	2.85	1.6	.75	.7	.95	.7	.8
17	1.2	1.2	.7	1.0	2.0	2.7	1.6	.75	.7	.95	.7	.9
18	1.2	1.2	.7	1.1	2.0	2.6	1.5	.75	.7	.9	.75	.9
19	1.3	1.2	.7	1.2	2.1	2.5	1.45	1.0	.7	.9	.75	.9
20	1.4	1.2	.7	1.5	3.0	2.5	1.4	1.1	.7	.85	.75	.9
21	1.7	1.2	.8	1.4	2.7	2.5	1.4	.8	.7	.8	.75	1.0
22	1.6	1.3	.8	1.3	2.7	2.5	1.4	.8	.7	.8	.75	1.0
23	1.9	1.8	.8	1.4	2.8	2.5	1.4	1.5	.7	.8	.75	1.0
24	1.8	1.0	1.0	1.4	2.8	2.35	1.4	1.5	.7	.8	.75	1.0
25	1.7	.9	1.0	1.3	3.0	2.1	1.4	1.0	.7	.75	.75	1.0
26	1.6	2.0	.8	1.2	2.7	2.0	1.4	.9	.7	.75	.75	1.0
27	1.5	1.2	.8	1.3	2.7	1.8	1.4	.9	.7	.8	.75	1.0
28	1.4	1.2	.7	1.4	2.2	1.8	1.4	.9	.7	.8	.75	1.0
29	1.4	1.2	.8	1.6	2.2	1.8	1.4	.85	.7	.8	.75	1.0
30	1.3	.....	.8	1.6	2.4	1.8	1.35	.8	.7	.75	.75	1.0
31	1.3	.....	.8	.....	2.5	.....	1.3	.8	.....	.7	.....	1.0

[a] Creek frozen most of the time from January 1 to March 15 and December 1 to 31

Rating table for Clear Creek at Buffalo, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	7	1.00	32	1.80	202	2.60	486
.65	9	1.10	42	1.90	234	2.70	526
.70	11	1.20	54	2.00	266	2.80	566
.75	14	1.30	70	2.10	302	2.90	606
.80	17	1.40	92	2.20	338	3.00	646
.85	20	1.50	116	2.30	374	3.10	686
.90	24	1.60	140	2.40	410	3.20	726
.95	28	1.70	170	2.50	446		

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of Clear Creek at Buffalo, Wyo., for 1904.

[Drainage area, 118 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 16–31	32	11	16.6	527	0.141	0.084
April	140	17	52.4	3,118	.444	.495
May	646	170	377	23,180	3.19	3.68
June	706	202	421	25,050	3.57	3.98
July	546	70	174	10,700	1.47	1.70
August	116	14	35.6	2,189	.302	.348
September	17	11	13.0	774	.110	.123
October	28	11	16.7	1,027	.142	.164
November	14	11	12.3	732	.104	.116
The period				67,300		

PINEY CREEK AT KEARNEY, WYO.

This station was established September 6, 1902, by Jeremiah Ahern. It is located at the highway bridge at Kearney, Johnson County, Wyo., which is on the stage route between Sheridan and Buffalo, 24 miles from Sheridan. The gage is a vertical staff graduated to feet and tenths and spiked to the abutment of the bridge. It is read daily by R. D. Noyce. The initial point for soundings is on the right bank. Discharge measurements are made from the bridge. The channel is straight for 600 feet above and 200 feet below the station. The left bank is high and liable to overflow at extreme high water. The right bank is high and does not overflow. The bed of the stream is composed of gravel. The bench mark is the U. S. G. S. bench mark at Geier's ranch, about 600 feet from the gage. It is marked "SHER 4662." Its elevation is 4,661.767 feet above sea level. The elevation of the zero of the gage as referred to this bench mark is 4,645.963 feet.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Piney Creek at Kearney, Wyo., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 31	A. J. Parshall	42	0.95	1.50	40
May 9	do	106	2.82	2.55	299
May 20	do	149	5.03	3.10	749
May 21	do	134	4.62	2.95	620
June 12	do	125	4.24	2.85	530
July 8	do	92	1.42	2.05	131
July 18	do	84	1.03	1.85	87
September 12	do	49	0.45	1.30	22
October 12 [a]	do	18	1.83	1.40	33

[a] Wading one-fourth mile above station.

Mean daily gage height, in feet, of Piney Creek at Kearney, Wyo., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[b]
1	1.5	1.45	1.5	1.6	2.35	3.08	2.1	1.5	1.2	1.18	1.5	.....
2	1.5	1.45	1.5	1.55	2.5	2.9	2.5	1.5	1.2	1.18	1.5	.....
3	1.5	1.45	1.5	1.55	3.13	2.82	2.5	1.45	1.2	1.18	1.35	.....
4	1.5	1.4	1.5	1.6	3.1	2.72	2.42	1.45	1.2	1.25	1.35	.....
5	1.5	1.4	1.5	1.6	3.0	2.85	2.32	1.4	1.2	1.25	1.35	.....
6	1.5	1.4	1.5	1.7	2.9	3.0	2.3	1.4	1.2	1.25	1.35	.....
7	1.5	1.4	1.5	1.8	2.85	3.0	2.27	1.4	1.2	1.25	1.35	.....
8	1.5	1.4	1.5	1.7	2.8	3.25	2.22	1.35	1.2	1.25	1.35	.....
9	1.5	1.4	1.45	1.7	2.7	2.98	2.12	1.3	1.2	1.25	1.35	.....
10	1.5	1.4	1.45	1.75	2.7	3.0	2.08	1.35	1.2	1.25	1.35	.....
11	1.5	1.4	1.45	1.8	2.65	3.18	2.02	1.4	1.2	1.25	1.35	.....
12	1.5	1.45	1.45	1.9	2.6	2.9	2.01	1.4	1.2	1.25	1.3	.....
13	1.5	1.45	1.45	1.9	2.55	2.8	2.08	1.4	1.2	1.4	1.3	.....
14	1.5	1.45	1.5	2.0	2.55	2.98	2.02	1.4	1.2	1.4	1.35	.....
15	1.5	1.45	1.5	2.0	2.6	3.1	1.95	1.4	1.25	1.35	1.35	.....
16	1.5	1.45	1.5	2.0	2.6	3.1	1.92	1.4	1.25	1.35	1.38	.....
17	1.5	1.45	1.5	2.05	2.65	3.08	1.9	1.4	1.25	1.4	1.38	.....
18	1.5	1.45	1.5	2.0	2.7	2.99	1.84	1.35	1.22	1.5	1.38	.....
19	1.5	1.45	1.5	2.0	2.8	3.02	1.72	1.35	1.22	1.5	1.38	.....
20	1.5	1.45	1.5	2.1	3.2	2.92	1.62	1.35	1.22	1.5	1.38	.....
21	1.45	1.45	1.5	2.15	2.9	2.85	1.58	1.4	1.2	1.5	1.35	.....
22	1.45	1.45	1.5	2.2	3.3	2.85	1.52	1.4	1.2	1.5	1.35	.....
23	1.45	1.5	1.5	2.2	3.45	2.70	1.5	1.3	1.2	1.5	1.35	.....
24	1.45	1.5	1.5	2.2	3.25	2.72	1.5	1.25	1.2	1.5	1.35	.....
25	1.45	1.5	1.5	2.25	3.2	2.42	1.68	1.2	1.2	1.5	1.35	.....
26	1.45	1.5	1.5	2.25	2.9	2.28	1.62	1.2	1.18	1.5	1.35	.....
27	1.45	1.5	1.5	2.25	2.8	2.08	1.58	1.2	1.18	1.5	1.35	.....
28	1.45	1.5	1.5	2.3	2.75	2.00	1.55	1.2	1.18	1.5	1.35	.....
29	1.45	1.5	1.55	2.3	2.85	2.04	1.51	1.2	1.18	1.5	1.35	.....
30	1.45	.....	1.6	2.35	3.0	2.10	1.5	1.2	1.18	1.5	1.35	.....
31	1.45	.....	1.6	.....	3.15	.....	1.5	1.2	.....	1.5	.....	.....

[a] Frozen greater portion of time, January 1 to March 15.
[b] Frozen during month.

Rating table for Piney Creek at Kearney, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.15	12	1.50	38	2.20	178	2.90	580
1.20	15	1.60	48	2.30	218	3.00	660
1.25	18	1.70	60	2.40	262	3.10	750
1.30	21	1.80	76	2.50	310	3.20	850
1.35	25	1.90	96	2.60	364	3.30	960
1.40	29	2.00	118	2.70	430	3.40	1,080
1.45	33	2.10	144	2.80	500	3.50	1,200

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904. It is well defined between gage heights 1.3 feet and 3 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Piney Creek at Kearney, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 16–31	48	38	39.6	1,257
April	240	43	122	7,260
May	1,140	240	566	34,800
June	905	118	534	31,780
July	310	38	117	7,194
August	38	15	25.2	1,550
September	18	14	15.2	904
October	38	14	28.2	1,734
November	38	21	25.9	1,541
The period	.....	.....	.....	88,020

LITTLE MISSOURI RIVER NEAR ALZADA, MONT.

This station was established April 3, 1904, by F. M. Madden. It is located at the highway bridge on the old Spearfish and Miles City stage road, about one-half mile northwest of Alzada, Mont. A plain staff gage, graduated to feet and tenths, is attached vertically to the downstream side of the crib pier supporting the middle of the bridge. It is read once each day by Miss Elsie King. Discharge measurements are made at high stages from the downstream side of the two-span bridge to which the gage is attached. During low-water periods measurements are made by wading near the gage. The initial point for soundings is a bolt in the downstream hand rail near the left end

of the bridge. The channel is straight above and below the station for about 200 feet and the current is moderately swift. Both banks are high, but subject to overflow in extreme high water. The bed of the stream is composed of fine silt and is permanent. Below the section willows grow in some places so that the branches reach nearly across the channel. There is but one channel, broken by the middle crib pier of the bridge. The large rock-filled crib pier and ice breaker just above are the only obstructions in the channel at the station. Willows and brush on the banks tend to retard the flow during high water. Bench mark No. 1 is a spike driven into the base of a tree about 50 feet west of the left end of the bridge. Its elevation is 16.33 feet above the zero of the gage. Bench mark No. 2 is a United States Geological Survey standard bench mark in the town of Alzada, distant about 2,000 feet. Its elevation is 26.82 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Little Missouri River near Alzada, Mont., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 3	F. M. Madden	54	218	1.72	5.70	376
April 3	do	50	176	1.73	4.90	305
May 9	do	21	52	1.60	2.50	83
May 10	do	21	46	1.35	2.20	62
June 26	F. C. Magruder	18	29	.38	1.40	11
July 8 [a]	F. M. Madden	9	4.6	1.00	1.25	4.6
July 9 [a]	do	14	3.7	1.16	1.20	4.3
September 5 [b]	do	23	67	1.22	2.90	82

[a] At wading section.
[b] Flow lessened by large growth of willows during July and August.

Mean daily gage height, in feet, of Little Missouri River near Alzada, Mont., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	12.7	1.2	1.3	1.4	1.1	1.6	(a)	1.1
2	9.0	4.7	2.7	1.4	1.1	1.6	0.9	1.1
3	5.3	4.7	7.2	1.3	1.1	4.8	1.0	1.1
4	5.0	2.3	17.0	1.3	1.1	8.6	1.0	1.1
5	5.2	1.7	17.0	1.3	1.0	3.4	1.1	1.1
6	5.3	1.5	17.0	1.3	1.0	1.8	1.1	1.1
7	3.5	1.7	16.0	1.3	.9	1.7	1.1	1.1
8	2.75	1.4	5.3	1.3	.9	1.5	1.1	1.1
9	2.2	2.5	5.0	1.7	.9	1.3	1.1	1.1
10	2.0	2.2	5.1	1.8	.9	1.2	1.1	1.1
11	1.7	1.7	4.8	1.8	.9	1.2	1.1	1.1
12	1.5	1.5	3.0	1.5	.9	1.2	1.1	1.1
13	1.6	1.3	2.8	1.3	.9	1.2	1.1	1.1
14	1.65	1.3	2.2	1.3	.9	1.1	1.1	1.1
15	1.6	1.3	2.0	1.1	.9	1.05	1.1	1.1
16	1.5	1.3	1.9	1.1	.9	1.0	2.1	1.1
17	1.45	1.2	1.8	1.15	.9	.9	2.1	1.1
18	1.3	1.2	1.7	1.15	.9	.9	1.5	1.1
19	1.2	1.2	1.7	1.15	.9	.9	1.4	1.1
20	1.2	1.2	1.7	1.15	.9	.9	1.2	1.1
21	1.2	1.2	1.7	1.15	.9	.8	1.1	1.1
22	1.2	2.0	1.7	1.1	.9	(a)	1.1	1.1
23	1.2	1.5	1.7	1.1	.9	(a)	1.1	1.1
24	1.2	4.5	1.7	1.1	.9	(a)	1.1	1.1
25	1.2	2.3	1.5	1.1	.9	(a)	1.1	1.1
26	1.2	3.0	1.5	1.1	.9	(a)	1.1	1.1
27	1.2	2.5	1.5	1.1	.9	(a)	1.1	1.1
28	1.2	1.7	1.4	1.1	.9	(a)	1.1	1.1
29	1.2	1.5	1.6	1.1	.9	(a)	1.1	1.1
30	1.2	1.4	1.4	1.1	1.9	(a)	1.1	1.1
31	.....	1.3	.....	1.1	1.9	.....	1.1	.....

a River dry.

Rating table for Little Missouri River near Alzada, Mont., from April 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	1	2.30	69	3.60	178	4.90	300
1.10	2	2.40	77	3.70	187	5.00	310
1.20	4	2.50	85	3.80	196	5.10	320
1.30	7	2.60	93	3.90	205	5.20	330
1.40	11	2.70	101	4.00	214	5.30	340
1.50	15	2.80	109	4.10	223	5.40	350
1.60	20	2.90	117	4.20	232	5.50	360
1.70	25	3.00	125	4.30	241	5.60	370
1.80	31	3.10	133	4.40	250	5.70	380
1.90	38	3.20	142	4.50	260	5.80	390
2.00	45	3.30	151	4.60	270	5.90	400
2.10	53	3.40	160	4.70	280	6.00	411
2.20	61	3.50	169	4.80	290		

The preceding table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 1 foot and 6 feet. Discharges above gage height 6 feet are approximate estimates only. After August 29 reduce discharges as given by the table 30 per cent on account of back water effect of willows in channel below the gage. The flow is estimated as 0 second-feet at gage height .9 feet.

Estimated monthly discharge of Little Missouri River near Alzada, Mont., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,185	4	127	7,557
May	280	4	51.6	3,173
June	1,744	7	314	18,680
July	31	2	7.1	437
August [a]	27	0	2.0	123
September [a]	488	0	30.0	1,785
October [a]	37	0	4.1	252
November [a]	1.4	1.4	1.4	83
The period				32,090

[a] Estimates August 30 to November 30 approximate. See paragraph under rating table.

LITTLE MISSOURI RIVER NEAR CAMP CROOK, S. DAK.

This station was established September 2, 1903, by R. F. Walter, assisted by W. T. Carpenter. The station is at the highway bridge on the road from Camp Crook to Belle Fourche, about one-half mile from Camp Crook. The gage is a vertical 2 by 4 inch pine timber fastened to the first pier from the west end of the bridge, on the downstream side. It is graduated to feet and tenths with bronze figures marking the foot marks. The bridge at this station was destroyed March 9, 1904, by an ice jam which carried away the superstructure and nearly all of the two center piers, to one of which the gage was spiked. Records were kept by referring the height of the water to a temporary mark until the gage was reestablished April 10, by spiking a 2 by 4 inch pine gage to the east abutment and continuing the gage for low water on a 2 by 2 inch pine strip spiked to the remains of the pier near the east bank. The gage was read once each day by L. P. Chuning. Readings were discontinued November 13, as the gage was removed in preparing foundations for a new bridge. Discharge measurements were made from the bridge until it was destroyed, since which time they have been made by wading and by means of a boat or floats during extreme high water. The initial point for soundings was a brass-headed tack surrounded by four similar tacks driven into the end post of the hand rail at the west end

and downstream side of the bridge. The channel is straight for 300 feet above and 200 feet below the station. The current has a moderate velocity. The right bank is high and not subject to overflow. The left bank is subject to overflow at high water. Both banks are sparsely wooded. The bed of the stream is covered with stones, the largest of which are about 1 foot in diameter. The water flows in one channel at medium and high stages. Bench mark No. 1 is a large spike driven into a blaze on a tree 6 inches above the ground. The tree is at the side of the road, 100 feet from the end of the bridge, on the right bank. The elevation of the bench mark above the zero of the gage is 10.53 feet. Bench mark No. 2 is a large spike driven into a blaze on a tree about 6 inches above ground. The tree is on the opposite side of the road from the first bench mark and is 175 feet farther downstream. The elevation of the bench mark above the zero of the gage is 12.89 feet.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Little Missouri River near Camp Crook, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 10	F. M. Madden	100	124	2.11	1.60	262
May 10	do	61	47	1.15	.80	54
July 7	do	56	49	1.26	.85	62
September 6	do	108	214	2.84	2.60	609
September 7	do	100	141	2.28	1.90	321
September 7	do	100	131	2.21	1.80	289
September 7	do	98	116	2.03	1.55	235
October 26	do	40	19	.68	.45	13

Mean daily gage height, in feet, of Little Missouri River near Camp Crook, S. Dak., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.0	0.65	1.0	0.6	(b)	2.25	(b)	(b)
2	.....	5.7	.7	.9	.8	(b)	2.0	(b)	(b)
3	.....	5.5	.7	1.0	.9	(b)	1.5	(b)	(b)
4	.....	5.2	1.0	3.5	.9	(b)	1.3	(b)	(b)
5	2.8	4.0	1.8	8.0	.9	(b)	2.1	(b)	(b)
6	2.7	4.2	1.1	(a)	.7	(b)	2.65	(b)	(b)
7	2.6	3.5	1.0	(a)	.85	(b)	1.7	(b)	(b)
8	2.68	2.0	.9	6.4	.75	(b)	1.2	(b)	(b)
9	2.7	1.5	.85	4.0	.75	(b)	1.3	(b)	(b)
10	6.0	1.6	.8	3.2	.7	(b)	1.3	(b)	(b)
11	5.32	1.35	.8	2.9	.7	(b)	1.2	(b)	(b)
12	5.0	1.2	.8	2.7	.6	(b)	1.0	(b)	(b)
13	5.7	1.0	.8	2.3	.75	(b)	.8	(b)	(c)
14	4.25	.9	.8	1.8	.8	(b)	.55	0.3	.....
15	4.22	.9	.8	1.6	.7	(b)	.5	.2	.....
16	4.8	1.0	.8	1.5	.7	(b)	.5	(b)	.....
17	4.6	.9	.75	1.4	.7	(b)	.55	(b)	.....
18	4.7	.9	.75	1.1	.7	(b)	.55	(b)	.....
19	4.8	.8	.75	1.0	.7	(b)	.5	(b)	.....
20	4.7	.8	.75	.9	.7	(b)	.4	(b)	.....
21	4.6	.8	.7	.8	.65	(b)	.4	(b)	.....
22	4.4	.7	.55	.7	.5	(b)	.35	(b)	.....
23	4.3	.7	.55	.8	.5	(b)	.3	(b)	.....
24	4.3	.7	.6	.9	.5	(b)	.3	(b)	.....
25	4.3	.7	.6	1.0	.5	(b)	.2	(b)	.....
26	4.2	.7	3.9	1.0	.45	(b)	.2	(b)	.....
27	4.2	.7	3.3	.9	.45	(b)	.1	(b)	.....
28	4.6	.65	2.95	.8	.45	(b)	.1	(b)	.....
29	4.6	.65	1.5	.7	.4	(b)	.1	(b)	.....
30	5.0	.65	1.3	.6	.4	(b)	(b)	(b)	.....
31	5.5	.....	1.0	.....	(b)	(b)	.....	(b)	.....

a Water over gage.
b Water below gage.
c Station was closed on November 13, as gage was removed to construct new bridge.

Rating table for Little Missouri River near Camp Crook, S. Dak., from March 5 to November 13, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	1	0.90	71	1.70	270	2.40	522
.20	3	1.00	90	1.80	302	2.50	563
.30	6	1.10	110	1.90	335	2.60	605
.40	11	1.20	132	2.00	370	2.70	648
.50	18	1.30	156	2.10	406	2.80	691
.60	28	1.40	182	2.20	443	2.90	735
.70	40	1.50	210	2.30	482	3.00	779
.80	54	1.60	239				

The preceding table is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 0.40 foot and 2.60 feet. Discharges above gage height 3 feet are estimated on the basis of the extension of the discharge curve. Estimates below 0.40 foot gage height are uncertain.

Estimated monthly discharge of Little Missouri River near Camp Crook, S. Dak., for 1904.

[Drainage area, 1,900 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 5–31	2,185	605	1,407	75,350	0.741	0.744
April	2,185	34	454	27,020	.239	.267
May	1,189	23	157	9,654	.083	.096
June, 28 days [a]	3,180	28	419	23,270	.221	.230
July [b]	71	0	35.8	2,201	.019	.022
August [b]	.....	.....	.....	.....	.....	.....
September [b]	626	0	113	6,724	.059	.066
October [b]	6	0	0.29	18	.0002	.0002
The period	.....	.....	.....	144,200	.....	.....

[a] Water over gage June 6 and 7. No estimate made.
[b] Water below gage; July 31 to August 31, September 30 to October 18, and October 16 to November 13; estimated zero flow.

LITTLE MISSOURI RIVER NEAR MEDORA, N. DAK.

This station was established May 12, 1903, by F. E. Weymouth. It is located at the Northern Pacific Railway bridge, one-third mile west of the railroad station at Medora, N. Dak. A standard chain gage is located on the lower side of the railroad bridge at a point 91 feet from the initial point for soundings. The length of the chain from the end of the weight to the marker is 30.75 feet. The stream cross section having been changed by the railroad a new chain and weight length of 31.12 feet was established on June 29, 1904, which made the reading agree with the timber gage. There is also a 1 by 6 inch vertical board gage, reading from 1 to 9 feet, nailed to a pile in the river about 200 feet above the bridge. The gage is read once each day by W. A. Brubaker. Discharge measurements are made from the railroad bridge to which the gage is attached. The initial point for soundings is the left end of the guard rail on the lower side of the bridge. This point is 2.9 feet west of the east face of the concrete abutment. The guard rail is marked and numbered every 10 feet with white paint. The channel is straight for 100 feet above the station and for 300 feet below. The right bank is low and overflows at very high stages. The left bank is almost perpendicular and has a height of 30 feet above

gage datum. There is but one channel, broken by one to three piers, according to the stage of the river. The bed of the stream is of clay and sand and sometimes scours from 5 to 8 feet during floods. At ordinary stages the bed of the stream changes only slightly. About November 1, 1903, the cross section at the bridge was temporarily changed by the railroad company during repairs to the bridge, continuing several months. The bench mark is the top of the southwest corner of the concrete abutment on the left bank. Its elevation above gage datum is 30.11 feet. The top of the gage pulley is 31.05 feet above gage datum. The gage datum is about 2,230 feet above sea level, as determined by hand level from the railroad station at Medora, N. Dak.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Little Missouri River near Medora, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 12	E. F. Chandler	136	475	3.04	5.91	1,444
June 29	R. Richards	69	149	1.59	4.16	236
June 30	do	68	143	1.54	4.04	221
August 3	do	30	76	.25	3.21	19
August 4 [a]	do	25	12	.91	3.20	11
September 7 [a]	E. F. Chandler	28	73	.37	3.30	27
October 27 [a]	L. L. Wilcox	18	9	2.36	3.23	21.5

[a] Measurement made by wading.

Mean daily gage height, in feet, of Little Missouri River near Medora, N. Dak., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	3.0	.....	6.5	4.2	3.7	4.2	3.2	3.3	2.8	3.2	.....
2	.....	.....	.....	7.0	4.0	4.8	4.2	3.2	3.4	2.8	3.2	.....
3	.....	.....	.....	6.5	4.0	5.6	4.0	3.2	3.3	2.8	3.3	.....
4	.....	.....	.....	6.3	3.9	6.0	4.0	3.1	3.3	2.7	3.2	.....
5	.....	.....	.....	6.2	3.9	5.5	3.8	3.1	3.4	2.7	3.2	.....
6	.....	.....	.....	6.2	4.2	7.25	4.3	3.0	3.3	2.7	3.2	.....
7	.....	.....	.....	6.8	4.4	7.15	4.4	2.8	3.9	2.7	3.1	.....
8	.....	.....	.....	6.7	4.3	10.75	4.0	2.8	4.3	2.7	3.1	.....
9	.....	.....	.....	5.8	4.0	10.75	3.9	2.9	4.2	2.5	3.1	.....
10	3.4	.....	4.8	5.9	4.0	8.75	3.8	3.0	4.0	2.4	3.1	.....
11	.....	.....	.....	4.5	3.8	7.9	3.6	3.2	4.0	3.5	3.1	.....
12	.....	.....	.....	4.5	3.8	6.25	3.4	3.1	3.8	3.6	3.1	.....
13	.....	.....	5.0	4.3	3.8	5.55	3.4	3.0	3.8	3.6	3.2	.....
14	.....	.....	5.6	4.3	3.8	4.85	3.4	3.0	3.8	3.5	3.2	.....
15	.....	.....	5.0	4.3	4.0	4.2	3.4	3.1	3.8	3.5	3.2	.....
16	.....	.....	5.7	4.3	4.0	4.0	3.4	3.1	3.7	3.5	3.2	.....
17	.....	.....	5.0	4.0	3.9	4.0	3.4	3.0	3.6	3.4	3.2	.....

[a] River frozen from January 1 to March 12. Gage heights to under surface of ice.

Mean daily gage height, in feet, of Little Missouri River near Medora, N. Dak., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
18	.....	.....	5.8	4.0	3.8	4.0	3.5	3.0	3.6	3.4	3.2	.....
19	.....	.....	5.3	3.8	3.8	3.9	3.5	2.9	3.6	3.5	3.2	.....
20	3.0	3.0	5.0	4.8	3.8	3.9	3.4	3.1	3.4	3.6	3.2	.....
21	.....	.....	5.0	4.6	3.8	3.7	3.4	3.2	3.4	3.5	3.2	.....
22	.....	.....	4.8	4.0	3.8	3.8	3.4	3.2	3.2	3.5	3.2	.....
23	.....	.....	6.0	3.8	3.8	4.1	3.3	3.1	3.1	3.4	3.2	.....
24	.....	.....	5.9	3.8	3.6	4.0	3.3	3.0	3.2	3.4	3.2	.....
25	.....	.....	5.9	3.8	4.2	4.0	3.3	3.0	3.1	3.3	3.2	.....
26	.....	.....	4.6	3.5	4.5	3.8	3.5	3.1	3.1	3.2	3.2	.....
27	.....	.....	4.6	3.5	3.9	3.8	3.5	3.1	3.0	3.2	(a)	.....
28	.....	.....	4.6	3.5	3.7	3.8	3.4	3.2	3.0	3.2	.....	.....
29	.....	4.3	4.6	4.0	3.7	4.1	3.4	3.2	2.8	3.2	.....	.....
30	3.0	.....	5.8	4.4	3.7	4.2	3.4	3.2	2.8	3.0	.....	.....
31	.....	.....	7.0	.....	3.7	.....	3.3	3.2	.....	3.2	.....	.....

a River frozen from November 27 to December 31, inclusive.

Rating table for Little Missouri River near Medora, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	15	4.00	195	4.70	507	5.40	992
3.30	27	4.10	229	4.80	566	5.50	1,076
3.40	44	4.20	266	4.90	628	5.60	1,163
3.50	64	4.30	307	5.00	694	5.70	1,252
3.60	86	4.40	352	5.10	763	5.80	1,343
3.70	110	4.50	400	5.20	836	5.90	1,436
3.80	136	4.60	452	5.30	912	6.00	1,530
3.90	164						

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly defined between gage heights 3.2 feet and 6 feet. The daily discharges for gage heights beyond these limits have been estimated.

Estimated monthly discharge of Little Missouri River near Medora, N. Dak., for 1904.

[Drainage area, 6,625 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. Sq. mile.	Depth in inches.
March 13–31	2,480	452	986	37,160	0.149	0.105
April	2,480	64	797	47,420	.120	.134
May	352	86	180	11,070	.027	.031
June	6,042	110	1,193	70,990	.180	.201
July	352	27	103	6,333	.016	.018
August	15	4	10.1	621	.0015	.0017
September	307	4	80.3	4,778	.012	.013
October	86	2	33.1	2,035	.0050	.0058
November 1–26	27	10	13.7	706	.0021	.0020
The period				181,100		

KNIFE RIVER AT BRONCHO, N. DAK.

This station was established May 29, 1903, by F. E. Weymouth. It is located about 600 feet east of H. M. Haven's ranch house, where the post-office is located. The station is about 23 miles north of Hebron, N. Dak., which is on the Northern Pacific Railway. The standard chain gage is located on the right bank, with the pulley fastened to a 2 by 4 inch timber projecting horizontally. The length of the chain from the end of the weight to the leather marker is 29.89 feet. The hor izontal scale is marked with white paint and reads from zero to 16 feet The elevation of the center of pulley above gage zero is 18 feet. Two bench marks were established October 23, 1904. Bench mark No. 1 is the top of the post holding shore end of horizontal gage rod; elevation 18.26 feet above gage zero. Bench mark No. 2 is cross cut in the top of a gray bowlder set flush with surface of the ground about 5 feet behind crest of bank and in line with horizontal gage rod; elevation 27.27 feet. A temporary 2 by 4 inch vertical board gage is spiked to a tree on the right bank above the ford, three-fourths of a mile below the ranch. It reads from zero to 19.3 feet. The gage is read once each day by Sarah J. Smith. Discharge measurements are made from a car and ½-inch cable with a span of 150 feet. The tag wire, consisting of barbed wire with zinc markers every 10 feet, is stretched about 5 feet east of the cable. The initial point for soundings is the post to which the right end of the tag wire is fastened. The channel is straight for 100 feet above the station and for 200 feet below. The current velocity is moderate. Both banks are high, with a few small trees and some brush. The bed of the stream is composed of sand and gravel and is probably fairly permanent. The bench mark for the temporary gage rod is a spike in the tree to which the gage is

fastened at an elevation of 19.25 feet above its zero. The gage zero is about 1,870 feet above sea level, as determined by carrying an aneroid barometer four times between this station and Hebron, N. Dak. The drainage area of Knife River at this station is 1,260 square miles.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Knife River at Broncho, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 9	E. F. Chandler	87	616	3.27	11.32	2,012
July 2[a]	R. Richards	16	23	.55	.86	13.5
August 6[a]	do	11	6.2	.47	.71	2.9
August 21[a]	E. F. Chandler	27	9	.62	.85	5.6
August 24[a]	do	26	7.4	.57	.80	4.2
October 29[a]	do	13	10	.53	.88	5.2

[a] Measurement by wading.

Mean daily gage height, in feet, of Knife River at Broncho, N. Dak., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.80	2.90	1.10	0.90	0.80	0.75	0.70	0.90
2	6.90	2.70	1.10	.85	.80	.75	.70	.90
3	10.20	2.40	1.10	.85	.80	.75	.70	.90
4	15.20	2.00	1.30	.85	.80	.70	.70	.90
5	18.40	2.00	1.30	.80	.80	.70	.70	.90
6	16.00	2.00	3.00	.80	.80	.70	.70	.90
7	14.40	1.80	2.40	.80	.80	.70	.70	.90
8	12.40	1.70	2.80	.80	.80	.70	.70	.90
9	11.40	1.60	1.70	.80	.80	.70	.70	.90
10	9.40	1.50	2.30	1.00	.80	.70	.70	.90
11	9.70	1.40	2.00	1.10	.75	.70	.70	.90
12	9.40	1.40	1.10	1.00	.75	.70	.75	.90
13	8.80	1.30	.70	1.00	.75	.70	.75	.90
14	6.70	1.30	.50	.95	.70	.70	.80	.90
15	5.40	1.30	1.30	.90	.70	.70	.80	.90
16	4.60	1.30	1.20	.85	.70	.70	.80	.90
17	3.70	1.30	1.20	.85	.70	.70	.80	.90
18	2.80	1.30	1.00	.80	.70	.70	.80	.90
19	2.20	1.30	1.00	.80	.75	.70	.80	.90
20	1.80	1.30	1.00	.80	.80	.70	.85	.90
21	1.80	1.25	1.00	.80	.80	.70	.85	.90
22	1.70	1.20	1.00	.80	.75	.70	.85	.90
23	1.60	1.15	1.00	.80	.75	.70	.85	.90
24	1.80	1.10	1.00	.80	.75	.70	.90	.90
25	2.00	1.10	1.00	.80	.75	.70	.90	.90
26	2.00	1.10	1.00	.80	.70	.70	.90	.90
27	2.00	1.10	1.00	.80	.70	.70	.90	.....
28	2.10	1.10	1.00	.80	.70	.70	.90	.....
29	2.20	1.10	1.00	.80	.70	.70	.90	.....
30	2.20	1.10	1.00	.80	.70	.70	.90	.....
31	.....	1.10	.....	.80	.70	.....	.90	.....

HEART RIVER NEAR RICHARDTON, N. DAK.

This station was established June 2, 1903, by F. E. Weymouth. It is located at the iron highway bridge 10 miles south of the Northern Pacific Railway station at Richardton, N. Dak. The standard chain gage is located on the lower side of the bridge. The scale, reading from 2 to 23 feet, is marked on the foot guard rail with wire staples and white paint marks. The length of the chain is 24.34 feet from the end of the weight to the marker. The gage is read once each day by W. F. Church. Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the end of the guard rail on the lower side of the bridge at the left bank. Distances are marked and numbered with white paint every 10 feet across the entire length of the bridge. The channel is straight for 150 feet above and below the station. The current velocity is moderate. Both banks are high and covered with brush. The bed of the stream is sandy and shifting. The bench mark is the top of the foot guard rail at a distance of 45 feet from the initial point for soundings. Its elevation is 25.58 feet above gage datum. The top of the gage pulley has this same elevation. Gage datum is 2,150 feet above sea level, as determined by carrying an aneroid barometer six times between this point and the railroad station at Richardton.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Heart River near Richardton, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 12	R. Richards and E. F. Chandler.	75	541	2.40	11.10	1,299
June 30 [a]	R. Richards	18	13	1.16	4.42	15
June 30 [a]	do	14	21	.68	4.42	14.5
August 4 [b]	do	1–2	0.13–0.51	.31–1.00	3.90	.2
October 27 [a]	L. L. Wilcox	8	4	.71	4.14	2.8

[a] By wading.

[b] By wading; average of 4 measurements.

Mean daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1904.

Day.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.80	5.70	4.50	4.40	3.90	4.00	3.90	4.20
2	12.40	5.70	4.50	4.40	3.90	4.00	3.90	4.20
3	17.90	5.60	4.80	4.40	3.90	4.00	3.90	4.20
4	19.30	5.50	4.90	4.40	3.90	4.00	4.00	4.20
5	21.50	5.40	5.00	4.40	3.90	4.00	4.00	4.20
6	20.30	5.20	5.70	4.40	3.90	4.00	4.10	4.20
7	17.10	5.20	6.60	4.40	3.90	4.00	4.10	4.20
8	14.70	5.10	7.10	4.30	3.90	4.00	4.10	4.20
9	12.30	5.00	6.20	4.30	3.90	4.00	4.10	4.20
10	11.30	4.90	6.00	4.30	3.90	4.00	4.10	4.20
11	11.50	4.90	5.80	4.30	3.90	4.00	4.10	4.20
12	11.70	4.80	5.60	4.30	3.90	4.00	4.10	4.20
13	10.40	4.80	5.50	4.30	3.90	4.00	4.10	4.20
14	9.10	4.80	5.40	4.30	3.90	4.00	4.10	4.20
15	8.20	4.70	5.30	4.20	3.90	4.00	4.10	4.20
16	7.70	4.70	5.20	4.20	3.90	4.00	4.10	4.20
17	7.10	4.70	4.90	4.20	3.90	4.00	4.10	4.10
18	6.80	4.70	4.70	4.20	4.00	4.00	4.10	4.10
19	6.60	4.70	4.60	4.10	4.10	4.00	4.10	4.10
20	6.50	4.60	4.50	4.10	4.10	4.00	4.10	4.10
21	6.30	4.60	4.50	4.10	4.10	3.90	4.10	4.10
22	6.10	4.60	4.60	4.00	4.10	3.90	4.10	4.10
23	5.90	4.60	4.80	4.00	4.00	3.90	4.10	4.10
24	5.70	4.60	4.80	4.00	4.00	3.90	4.10	4.10
25	5.70	4.60	4.70	4.00	4.00	3.90	4.10	4.10
26	5.70	4.50	4.60	3.90	3.90	3.90	4.20	4.10
27	5.60	4.50	4.50	3.90	3.90	3.90	4.20	4.10
28	5.60	4.50	4.50	3.90	4.00	3.90	4.20	4.10
29	5.60	4.50	4.40	3.90	4.00	3.90	4.20	4.10
30	5.70	4.50	4.40	3.90	4.00	3.90	4.20	4.10
31	.....	4.50	.....	3.90	4.00	.....	4.20	.....

Rating table for Heart River near Richardton, N. Dak., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	0.2	4.70	34	5.50	128	6.30	252
4.00	1	4.80	43	5.60	142	6.40	269
4.10	2	4.90	53	5.70	157	6.50	287
4.20	4	5.00	64	5.80	172	6.60	305
4.30	8	5.10	75	5.90	187	6.70	323
4.40	13	5.20	87	6.00	203	6.80	342
4.50	19	5.30	100	6.10	219	6.90	361
4.60	26	5.40	114	6.20	235	7.00	380

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904 and 1 made in 1903. It is fairly well

defined between gage heights 3.9 feet and 5 feet. Above 5 feet all estimates are based upon a measurement at 11.1 gage height, and can only be considered as rough approximations.

Estimated monthly discharge of Heart River near Richardton, N. Dak., for 1904.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April[a]	4,115	142	1,128	67,120	0.902	1.01
May	157	19	54.4	3,345	.044	.051
June	400	13	87.6	5,213	.070	.078
July	13	0.2	5.62	346	.0045	.0052
August	2	.2	.64	39	.00051	.00059
September	1	.2	.73	43	.00058	.00065
October	4	.2	2.14	132	.0017	.0020
November	4	2.0	3.07	183	.0025	.0028
The period				76,420		

[a] Discharge estimates April 1–15 are rough approximations.

CANNON BALL RIVER NEAR STEVENSON, N. DAK.

This station was established June 10, 1903, by F. E. Weymouth. It is located one-half mile west-northwest of the post-office at Stevenson, in sec. 20, T. 133 N., R. 82 W., and is about 40 miles south of Mandan, N. Dak. The standard chain gage is located on the left bank. The pulley is fastened to a horizontal timber at a point 10.08 feet from the zero of the scale. The length of the chain from the end of the weight to the end of the chain and ring is 26.09 feet. It is read once each day by Donald Stevenson. Discharge measurements are made from a $\frac{3}{4}$-inch wire cable and car about 200 feet above the gage. The left end of the cable is supported by a post 3 feet above ground and 10 feet back from the crest of the bank, and is fastened to a 4-foot log anchor buried in the ground. This end of the cable is about 34 feet above gage datum. The right end of the cable is attached to a 13-inch cottonwood tree at a point 12 feet above ground and 30 feet above the gage datum. The tree is guyed by a cable attached to a log anchor buried in the ground. A tag wire, consisting of barbed wire with zinc markers every 10 feet, is stretched above the cable. The initial point for soundings is a point 2 feet back from the cable support on the left bank. The channel is straight for 100 feet above the station and for 400 feet below. The current velocity is sluggish at ordinary stages. The right bank is low and is a gradual

slope up from the water's edge. It is covered with timber and brush. The left bank is steep and about 25 feet high. Bench mark No. 1 is the highest point of a bowlder, whose dimensions are 6 by 8 feet, located in the stream about 600 feet below the gage, toward the right bank. Its elevation above gage datum is 4.84 feet. Bench mark No. 2 is on the post to which the shore end of the horizontal gage rod is attached. It is the top surface of notch in which the gage rod rests. Elevation 15.99 feet above gage zero. Bench mark No. 3 is the top of the projecting pulley carrying the chain. Elevation 15.70 feet above gage zero. The datum of the gage is about 1,700 feet above sea level, as determined by carrying an aneroid barometer six times between this station and Mandan, N. Dak. The drainage area of Cannon Ball River at this station is 3,650 square miles. The bed of the stream consists of clay, soft mud, and loose stones, and is probably somewhat shifting. The depth varies from 2 to 5 feet at ordinary stages.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Cannon Ball River near Stevenson, N. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square ft.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
April 10	E. F. Chandler	158	686	3.45	7.18	2,366
July 4	Chandler and Richards.	104	156	.46	3.24	72
August 1	E. F. Chandler	37	30	.20	2.65	6
August 1 [a]	R. Richards	34	21	.25	2.64	5.2
October 25 [a]	L. L. Wilcox	7	3.8	.92	2.58	3.5

[a] Measurement made by wading.

Mean daily gage height, in feet, of Cannon Ball River near Stevenson, N. Dak., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	[b]7.8	3.7	3.2	3.6	2.6	2.3	2.6	2.8	.....
2	.....	.....	.....	9.1	3.7	[c]3.6	3.4	2.5	2.2	2.6	2.9	.....
3	.....	.....	.....	.....	3.5	5.7	3.3	2.5	2.2	2.6	2.9	.....
4	.....	.....	.....	.....	3.5	6.6	3.4	2.5	2.3	2.4	2.9	.....
5	.....	.....	.....	[d]7.8	3.5	6.3	3.1	2.4	2.3	2.4	2.8	.....
6	.....	.....	.....	6.6	3.5	6.2	3.1	2.4	2.2	2.3	2.8	.....
7	.....	.....	.....	7.2	3.4	5.6	3.2	2.4	2.2	2.2	2.8	.....
8	.....	.....	.....	7.3	3.4	3.9	3.1	2.3	2.1	2.2	2.8	.....
9	.....	.....	.....	7.8	3.5	[c]6.3	3.0	2.3	2.1	2.3	2.9	.....
10	.....	.....	.....	7.5	3.3	[c]6.7	3.0	2.3	2.0	2.3	2.8	.....
11	.....	.....	.....	6.6	3.3	5.6	3.1	2.2	2.0	2.4	2.7	.....
12	.....	.....	.....	5.7	3.3	5.2	3.2	2.0	2.1	2.6	2.7	.....
13	.....	.....	.....	5.4	3.3	5.0	3.2	2.0	2.1	2.6	2.7	.....
14	.....	.....	.....	5.2	3.3	4.7	3.1	1.8	2.1	2.6	2.7	.....

[a] River frozen over from January 1 to April 4.
[b] Old ice still solid.
[c] Heavy rains.
[d] Ice all out.

Mean daily gage height, in feet, of Cannon Ball River near Stevenson, N. Dak., in 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	.....	.....	.....	4.9	3.4	4.7	2.9	1.8	2.2	2.6	2.6	.....
16	.....	.....	.....	4.2	3.4	4.5	2.9	2.2	2.3	3.1	2.6	.....
17	.....	.....	.....	4.2	3.3	4.2	2.9	[a]2.7	2.3	3.1	2.6	.....
18	.....	.....	.....	4.1	3.3	3.8	2.9	2.9	2.3	3.4	2.4	.....
19	.....	.....	.....	4.2	3.3	3.9	2.7	2.9	2.3	3.4	2.4	.....
20	.....	.....	.....	4.2	3.3	3.9	2.8	2.7	2.4	3.3	2.7	.....
21	.....	.....	.....	4.1	3.2	3.6	2.8	2.7	2.4	2.7	2.7	.....
22	.....	.....	.....	4.1	3.4	3.6	2.6	2.7	2.5	2.6	2.6	.....
23	.....	.....	[b]5.9	4.0	3.4	3.5	2.7	2.6	2.5	2.6	2.6	.....
24	.....	.....	.....	4.0	3.3	3.5	2.7	2.6	2.6	2.6	2.6	.....
25	.....	.....	.....	4.0	3.2	3.6	2.7	2.4	2.6	2.7	2.6	.....
26	.....	.....	.....	3.9	3.2	3.6	2.8	2.3	2.6	2.7	2.6	.....
27	.....	.....	.....	3.9	3.2	3.4	2.7	2.3	2.7	2.7	2.7	.....
28	.....	.....	.....	3.7	3.1	3.3	2.7	2.3	2.7	2.6	2.7	.....
29	.....	.....	.....	3.7	3.0	3.2	2.6	2.4	2.6	2.6	2.7	.....
30	.....	.....	.....	3.7	3.0	3.1	2.6	2.4	2.6	2.8	([c])	.....
31	.....	.....	[b]6.8	.....	3.2	.....	2.6	2.3	.....	2.8	.....	.....

[a] Heavy rains.
[b] Water on top ice.
[c] River frozen over from November 29 to December 31, inclusive.

GRAND RIVER NEAR SEIM, S. DAK.

This station was established June 6, 1904, by F. M. Madden. It is located just below the junction of North and South forks of Grand River, near Seim, S. Dak. An inclined gage in two sections graduated to read direct to feet and tenths is fastened to a tree and posts set into the left bank. It is read daily by James McGee. Discharge measurements are made by wading or by the use of floats during high water. The initial point for soundings is the 3-foot mark of the gage. The channel is curved for about 200 feet above and 300 feet below the station, and the current is swift. The right bank is low, covered with scattering trees, and is subject to overflow. The left bank is high, clean, and does not overflow. The bed of the stream is composed of sand and gravel, free from vegetation, and permanent. There is but one channel at high water. During low stages there are three channels above and one below the gage. The slope of the channel is 5.89 feet to the mile, as determined from a 600-foot section at station. Bench mark No. 1 is a railroad spike in the tree to which the upper portion of the gage is attached. Its elevation is 9.10 feet above the zero of the gage. Bench mark No. 2 is a railroad spike driven into a cottonwood tree 125 feet from the left bank opposite the gage. Its elevation is 14.08 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Grand River near Seim, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec. feet.*
June 6	F. M. Madden	130	171	2.58	3.45	441
July 14[a]	do	20	6.5	.69	1.60	4.5

[a] 50 feet above station.

Mean daily gage height, in feet, of Grand River near Seim, S. Dak., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.1				
2		2.1				
3		2.1				
4		2.1				
5		2.1				
6	3.45	2.1				
7	3.0	2.1				
8	4.0	2.1				
9	3.9	2.1				
10	3.6	2.1				
11	3.1	2.1				
12	2.3	2.1				
13	2.3	2.1				
14	2.3	1.6				
15	2.2	(a)				
16	2.2	1.6				
17	2.2	1.6				
18	2.2	1.6				
19	2.2	1.6				
20	2.2	1.6				
21	2.2	(a)				
22	2.1					
23	2.1					
24	2.1					
25	2.1					
26	2.1					
27	2.1					
28	2.1					
29	2.1					
30	2.1					
31						

[a] Water below gage July 15 and from July 21 to November 19.

MOREAU RIVER NEAR BIXBY, S. DAK.

This station was established June 4, 1904, by F. M. Madden. It is located about 1,000 feet below the ford one-fourth mile southeast of Bixby, S. Dak. A plain staff gage is driven in an inclined position as far as possible into the bed of the stream and firmly spiked to two

small trees upon the right bank. In order to read gage heights in floods, the gage is continued on a large cottonwood tree, 50 feet from the lower rod, and divided so as to read direct. The gage is read once each day by J. A. Hudgins. Discharge measurements are made at ordinary stages by wading, and at flood water by means of floats. The initial point for soundings is the 7-foot mark on the gage. The channel is straight for about 300 feet above and curved for 300 feet below the station. The current is swift, becoming sluggish below the station at low water. The right bank is high, timbered, and does not overflow. The left bank is timbered and subject to overflow in extreme high water. The bed of the stream, composed of sandstone, containing much clay and fine sand, is free from vegetation and permanent. There is but one channel at all stages. Bench mark No. 1 is a railroad spike driven into and near the base of a cottonwood tree 75 feet from the gage on the right bank. Its elevation is 13.98 feet above the zero of the gage. Bench mark No. 2 is a railroad spike driven into and near the base of a cottonwood tree 100 feet from the gage and 75 feet downstream from the first bench mark. Its elevation is 13.95 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Moreau River near Bixby, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 4 [a]	F. M. Madden	86	225	2.80	3.6	631
June 7 [a]	do	87	251	3.07	3.9	771
June 8 [a]	do	85	199	2.66	3.3	530
July 12	do	46	10	1.00	1.5	10
July 12	do	82	117	1.22	2.25	143

[a] Flood measurement.

Mean daily gage height, in feet, of Moreau River near Bixby, S. Dak., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.4	1.2	1.8	1.3	1.3
2	.....	1.4	1.2	4.0	1.3	1.3
3	.....	1.4	1.2	2.7	1.3	1.3
4	.....	1.4	1.2	2.0	1.2	1.3
5	3.0	1.4	1.1	1.8	1.2	1.3
6	4.6	1.5	1.1	1.7	1.2	1.3
7	4.3	1.5	1.1	1.6	1.2	1.3
8	3.0	1.6	1.0	1.6	1.2	1.3
9	3.8	1.6	1.0	1.5	1.2	1.3
10	3.8	1.5	1.0	1.5	1.2	1.3
11	4.1	1.5	1.0	1.5	1.2	1.3
12	2.8	2.0	1.0	1.5	1.2	1.3
13	2.3	2.0	1.0	1.4	1.2	1.3
14	2.0	2.0	1.0	1.4	1.2	1.3
15	2.0	1.7	1.0	1.3	1.2	1.3
16	1.9	1.6	1.0	1.3	1.2	1.3
17	1.8	1.5	1.0	1.3	1.2	1.3
18	1.7	1.5	1.0	1.3	1.2	1.3
19	1.7	1.5	1.0	1.3	1.2	1.3
20	1.6	1.5	1.2	1.3	1.2	1.3
21	1.6	1.4	1.3	1.3	1.2	1.3
22	1.5	1.4	1.3	1.3	1.2	1.3
23	1.5	1.4	1.3	1.3	1.2	1.3
24	1.5	1.4	1.2	1.3	1.3	1.3
25	1.5	1.3	1.2	1.3	1.3	1.3
26	1.5	1.3	1.1	1.3	1.3	1.3
27	1.5	1.3	1.1	1.3	1.3	(a)
28	1.5	1.3	1.1	1.3	1.3	.....
29	1.5	1.3	1.1	1.3	1.3	.....
30	1.4	1.3	1.1	1.3	1.3	.....
31	.....	1.2	1.3	.....	1.3	.....

a Frozen November 27.

Rating table for Moreau River near Bixby, S. Dak., from June 5 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	0	2.00	84	2.90	340	3.80	722
1.35	2	2.10	104	3.00	378	3.90	770
1.40	4	2.20	128	3.10	418	4.00	818
1.45	7	2.30	156	3.20	458	4.10	866
1.50	10	2.40	184	3.30	500	4.20	914
1.60	18	2.50	212	3.40	544	4.30	966
1.70	30	2.60	240	3.50	588	4.40	1,018
1.80	46	2.70	272	3.60	632	4.50	1,070
1.90	64	2.80	304	3.70	676	4.60	1,122

The preceding table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is fairly well defined between gage heights 1.5 feet and 4 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Moreau River near Bixby, S. Dak., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 5–30	1,122	4	234	12,070
July	84	0	14.6	898
August	0	0	.0	0
September	818	0	46.0	2,737
October	0	0	.0	0
November	0	0	.0	0

CHEYENNE RIVER AT EDGEMONT, S. DAK.

This station was established June 19, 1903, by R. F. Walter. It is located at the highway bridge just downstream from the Burlington and Missouri River Railroad bridge. It is just above the junction of Cottonwood Creek and Cheyenne River. The gage is a vertical 2 by 4 inch timber graduated to feet and tenths, and fastened by bolts and iron bands to the downstream side of the middle steel pier of the bridge. The observer to September 1 was Loyd Stewart, who read the gage once each day. Hebert Wiedenfeld has beenthe observer since September 1, 1904. Discharge measurements are made from the highway bridge. The initial point for soundings is a brass-headed tack surrounded by four similar tacks in the first post of the hand rail on the west end of the bridge. The channel is straight above and below the station, and the current velocity is low. The right bank is high enough to prevent overflow, and is cleared. The left bank is low and subject to overflow; it has a few scattered trees. The bed of the stream is sandy and shifting. The water flows in two channels at low water and in one at high stages. Bench mark No. 1 is a nail surrounded by a circle of brass tacks driven into a knot on the south side of a cottonwood tree 250 feet north of the north end of the wagon bridge. Its elevation above the zero of the gage is 11.29 feet. Bench mark No. 2 is the corner of the abutment at the north end of the railroad bridge. It is on the fourth step of the abutment and on the corner on the east side away from the bridge. Its elevation above the zero of the gage is 20.23 feet. The drainage area above the station is 7,350 square miles.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Cheyenne River at Edgemont, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 15	F. M. Madden	29	15	1.4	1.75	21
May 14	do	66	29	1.24	2.00	36
May 26	do	147	266	2.79	3.40	743
June 18	do	146	212	2.48	3.20	526
August 6	do	5.5	1.5	.67	1.35	1
September 16	do	11	3.2	1.06	1.60	3.4

Mean daily gage height, in feet, of Cheyenne River at Edgemont, S. Dak., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.[a]	Dec.[a]
1	.....	2.0	3.5	5.6	2.3	1.7	3.6	1.6	1.5	2.5
2	.....	2.0	3.35	4.9	6.0	1.7	2.8	1.6	1.5	2.5
3	.....	2.0	3.0	8.0	5.55	1.7	2.3	1.6	1.5	2.5
4	.....	2.0	3.65	6.2	3.75	1.7	2.9	1.6	1.5	2.6
5	.....	2.0	3.15	5.0	2.9	1.7	2.4	1.6	1.5	2.6
6	.....	2.0	2.7	3.95	5.3	1.7	2.1	1.6	1.5	2.6
7	.....	2.0	2.6	3.55	4.7	1.7	2.0	1.6	1.5	2.6
8	.....	1.9	2.5	3.3	4.4	1.7	2.0	1.6	1.5	2.6
9	.....	1.9	2.4	5.85	4.2	1.7	1.8	1.6	1.5	2.6
10	.....	1.9	2.3	4.25	4.0	1.6	1.7	1.6	1.5	2.6
11	.....	1.8	2.2	3.7	3.7	1.6	1.7	1.7	1.5	2.6
12	.....	1.8	2.1	3.25	3.5	1.6	1.7	1.8	1.5	2.6
13	.....	1.8	2.0	2.8	4.1	1.6	1.6	2.0	1.6	2.6
14	.....	1.7	2.0	2.4	3.4	1.6	1.5	2.6	1.7	2.6
15	.....	1.7	2.0	2.2	3.0	1.5	1.5	2.7	1.6	2.6
16	2.4	1.7	2.0	3.55	2.7	1.5	1.5	2.5	1.6	2.6
17	2.3	1.7	2.0	3.3	2.5	1.5	1.5	2.4	1.5	2.6
18	2.2	1.7	2.0	2.8	2.3	1.5	1.5	2.2	1.5	2.6
19	2.0	1.7	2.0	2.4	2.1	1.5	1.4	2.0	1.5	2.6
20	2.0	1.7	2.0	2.2	2.0	1.5	1.4	1.7	1.5	2.6
21	2.0	1.7	6.4	2.1	2.0	1.5	1.4	1.7	1.8	2.6
22	2.0	1.6	5.7	3.8	1.9	1.4	1.4	1.7	1.8	2.6
23	2.0	1.6	4.8	3.4	2.0	1.4	1.4	1.7	2.0	2.6
24	2.0	1.6	3.8	3.0	1.9	1.4	1.4	1.6	2.2	2.6
25	2.0	1.5	3.55	2.6	1.8	1.4	1.4	1.6	2.3	2.6
26	2.0	1.5	3.35	2.4	1.8	1.4	1.4	1.6	2.3	2.6
27	2.0	1.5	3.2	2.9	1.7	1.4	1.4	1.6	2.4	2.6
28	2.0	1.5	3.1	2.7	1.7	1.4	1.9	1.6	2.4	2.6
29	2.0	1.5	3.0	2.6	1.7	1.4	1.9	1.6	2.4	2.6
30	2.0	1.5	2.9	2.5	1.7	3.4	1.7	1.5	2.4	2.6
31	2.0	.....	3.2	.....	1.7	4.2	.....	1.5	.....	2.6

[a] River frozen November 27 to December 31.

SPRING CREEK NEAR RAPID, S. DAK.

This station was established June 27, 1903, by R. F. Walter. It is located on the highway from Rapid to Hermosa, on the property of Frank

Blair. The gage is an upright 2 by 4 inch timber spiked to a tree at the water's edge about 100 feet above a small plank footbridge from which measurements of discharge are sometimes made. The gage is read once each day by Lyda Blair. The channel is straight for 100 feet above and 75 feet below the station. The water is sluggish above and below the footbridge, but has a high velocity where measurements are made. Both banks are low and subject to overflow. At the station the bed of the stream is gravelly; above and below this point it has a muddy bottom. Bench mark No. 1 is a steel nail driven into the tree to which the gage is attached. Its elevation is 2.14 feet above the zero of the gage. Bench mark No. 2 is a steel nail driven into the base of a tree about 50 feet upstream from the gage. Its elevation is 4.14 feet above the zero of the gage. Bench mark No. 3 is a steel nail driven into the roots of a tree about 75 feet downstream from the gage. Its elevation is 3.36 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrogapher.

Discharge measurements of Spring Creek near Rapid, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 17 [a]	F. M. Madden	16	11	0.58	0.93	6.4
June 26	do	22	43	2.72	2.10	117
August 15	do	19	21	.67	1.10	14
September 24	do	16	16	.38	.90	6

[a] Measurement by wading.

Mean daily gage height, in feet, of Spring Creek near Rapid, S. Dak., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		0.8	(a)	1.5	1.7	1.2	1.2	0.9	1.0
2		.7	(a)	1.5	1.7	1.2	1.1	.9	1.0
3		(a)	(a)	2.3	1.7	1.2	1.1	.9	1.0
4		(a)	0.7	2.5	1.7	1.2	1.0	.9	1.0
5		(a)	.9	2.5	1.7	1.2	1.0	.9	1.0
6		(a)	.9	2.4	1.7	1.2	1.0	.9	1.0
7		(a)	1.0	2.4	1.7	1.2	1.0	.9	1.0
8		(a)	1.0	2.7	1.6	1.1	1.0	.9	1.0
9		(a)	1.0	2.9	1.5	1.1	1.0	.9	.9
10		(a)	1.0	2.9	1.5	1.1	.9	.9	.7
11		(a)	.9	2.5	1.5	1.1	.9	.9	.9
12		(a)	.9	2.6	1.5	1.1	.9	.9	.9
13		(a)	.9	3.0	[b]8.4	1.1	1.0	.9	.9
14		(a)	.9	2.8	1.8	1.3	.9	1.0	.8
15		(a)	.9	3.0	1.8	1.1	.9	1.0	.9
16		(a)	.9	2.8	1.6	1.1	.9	1.0	.9

[a] Dry. [b] 8 p. m., gage height 4.3 feet; 6 p. m., gage height 2.5 feet.

high water. The bed of the stream is muddy, with embedded bowlders. At high water the stream flows in two channels, one of which is extremely small. The river is subject to rapid fluctuations in height, owing to the opening and closing of head-gates of a power plant above the station. Bench mark No. 1 is the top of a nail driven flush with the surface of the top of a low post at the south end of the bridge. Its elevation above the zero of the gage is 12.73 feet. Bench mark No. 2 is the upper surface of the lowest timber of the front doorsill of a house owned by Mr. Feigel. Its elevation above the zero of the gage is 18.12 feet. This is the first house on the west side of the road going north from the bridge. New bench marks were established at this station in spring of 1904, as the first ones established were apt to be disturbed. Bench mark No. 1, elevation 13.92 above zero of gage, is on a railroad spike driven near the base of the second tree from the southeast corner of dwelling, across the street from the School of Mines dormitory. Bench mark No. 2, elevation 12.81 above zero of gage, is on a railroad spike driven near the base of the first tree from the corner, south of the School of Mines dormitory.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Rapid Creek at Rapid, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 26	F. M. Madden	33	55	0.97	1.7	53
March 28	do	33	55	.91	1.7	50
April 23[a]	do	34	64	2.20	2.2	141
May 18	do	37	60	2.12	2.15	127
June 7	F. C. Magruder	41	131	5.08	3.8	665
June 21	F. M. Madden	35	114	3.80	2.8	433
August 8[b]	do	32	70	1.30	1.65	91
September 17[a]	do	36	49	1.82	1.6	89

[a] Wading. [b] Channel changed.

Mean daily gage height, in feet, of Rapid Creek at Rapid, S. Dak., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				1.95	2.18	2.22	2.45	1.68	1.8	1.55	1.6	1.58
2				1.92	2.20	2.3	2.3	1.62	2.15	1.55	1.6	(b)
3				1.92	2.25	2.5	2.35	1.58	1.85	1.6	1.6	(b)
4				2.0	2.22	2.82	2.32	1.68	1.72	1.48	1.55	(b)
5				2.08	2.2	3.45	2.3	1.62	1.68	1.55	1.55	(b)
6				2.02	2.23	4.3	2.3	1.68	1.48	1.55	1.58	1.48
7				2.0	2.25	3.7	2.3	1.6	1.65	1.55	1.58	1.45
8				2.08	2.25	3.55	2.25	1.52	1.55	1.62	1.5	1.48
9				2.08	2.2	3.5	2.22	1.6	1.58	1.58	1.6	1.55
10				2.08	2.2	3.4	2.18	1.68	1.45	1.58	1.6	1.58
11				2.05	2.2	3.45	2.2	1.5	1.55	1.6	1.58	1.65
12				2.08	2.2	3.4	2.12	1.58	1.6	1.6	1.6	1.5
13				2.1	2.2	3.35	2.28	1.55	1.65	1.65	1.6	1.62
14				2.15	2.2	3.2	2.22	1.6	1.6	1.7	1.58	1.55
15				2.2	2.2	3.12	2.10	1.58	1.52	1.68	1.62	1.48
16				2.2	2.2	3.08	2.08	1.52	1.55	1.65	1.6	1.45
17				2.18	2.2	2.95	2.00	1.55	1.62	1.7	1.62	1.52
18				2.15	2.15	2.85	1.92	1.55	1.45	1.62	1.62	1.38
19				2.15	2.1	2.8	1.92	1.62	1.5	1.68	1.6	1.48
20			1.95	2.15	2.1	2.8	1.88	1.65	1.6	1.62	1.65	1.38
21			1.9	2.12	2.12	2.8	1.90	1.60	1.42	1.6	1.65	1.45
22			1.85	2.15	2.2	2.72	1.88	1.45	1.48	1.62	1.58	1.35
23			1.85	2.15	2.22	2.68	1.85	1.48	1.55	1.6	1.6	1.58
24				2.15	2.22	2.82	1.88	1.48	1.5	1.6	1.62	1.68
25			1.7	2.15	2.25	2.72	1.78	1.48	1.52	1.6	1.62	(b)
26			1.7	2.15	2.25	2.68	1.85	1.45	1.55	1.58	1.6	(b)
27			1.68	2.15	2.25	2.58	1.7	1.45	1.62	1.6	1.6	(b)
28			1.7	2.15	2.25	2.52	1.72	1.38	1.55	1.6	1.5	(b)
29			1.8	2.14	2.2	2.42	1.75	1.38	1.48	1.58	1.62	(b)
30			2.0	2.14	2.2	2.32	1.68	1.5	1.48	1.6	1.55	1.5
31			1.95	.....	2.2	.....	1.75	1.42	.....	1.6	.....	1.62

[a] River frozen January 1 to March 19, inclusive.

[b] Frozen.

Rating table for Rapid Creek at Rapid, S. Dak., from January 1 to June 6, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	50	2.10	120	2.50	220	2.80	318
1.80	66	2.20	141	2.60	254	2.90	350
1.90	83	2.30	164	2.70	286	3.00	382
2.00	101	2.40	190				

NOTE.—The flood on June 7, 1904, changed the channel so as to require a new table for the remainder of the year. Neither table is accurate.

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 1.7 feet and 2.3 feet. The table has been extended beyond these limits. Above gage height 2.5 feet the rating curve is a tangent, the difference being 32 per tenth.

Mean daily gage height, in feet, of Box Elder Creek at Blackhawk, S. Dak., for 1904— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	.....	1.3	2.68	1.45	0.7	0.9	0.83	0.65	.....
16	.....	1.25	2.6	1.3	.7	.9	.83	.65	.....
17	.....	1.2	2.4	1.3	.7	.9	.83	.65	.....
18	0.8	1.1	2.25	1.2	.75	.88	.83	.65	.....
19	.8	1.1	2.2	1.15	.75	.85	.8	.65	.....
20	.95	1.1	2.15	1.1	.75	.85	.8	.7	.....
21	1.0	1.25	2.15	1.15	.75	.85	.8	.7	.....
22	1.1	1.4	2.1	1.2	.75	.85	.8	.7	.....
23	1.1	1.35	2.0	1.25	.75	.85	.8	.7	.....
24	1.05	1.3	2.3	1.2	.75	.85	.8	.7	.....
25	1.05	1.38	2.2	1.15	.75	.85	.8	.7	.....
26	1.05	1.44	2.0	1.15	.75	.85	.78	.7	.....
27	1.05	1.4	2.0	1.1	.75	.85	.75	.75	.....
28	1.05	1.35	1.8	1.1	.75	.85	.75	.75	.....
29	1.0	1.3	1.75	1.05	.75	.85	.75	.75	.....
30	.95	1.3	1.7	1.0	.75	.83	.73	.75	.....
31	.....	1.3	.....	.95	.75	.....	.7	.....	.....

NOTE: River frozen January 1 to April 17 and December 4 to 31.

Rating table for Box Elder Creek at Blackhawk, S. Dak., from June 27, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.55	0.0	1.30	31	2.40	154	3.50	326
.60	.5	1.40	39	2.50	168	3.60	342
.65	1.0	1.50	47	2.60	182	3.70	358
.70	1.5	1.60	57	2.70	198	3.80	374
.75	2.5	1.70	67	2.80	214	3.90	392
.80	4	1.80	78	2.90	230	4.00	410
.85	6	1.90	90	3.00	246	4.10	428
.90	8	2.00	102	3.10	262	4.20	446
.95	10	2.10	114	3.20	278	4.30	464
1.00	12	2.20	126	3.30	294	4.40	482
1.10	17	2.30	140	3.40	310	4.50	500
1.20	23						

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1903 and 1904. It is fairly well defined.

Estimated monthly discharge of Box Elder Creek at Blackhawk, S. Dak., for 1903 and 1904.

[Drainage area, 157 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
July	31	8	14.6	898	0.093	0.107
August	17	8	10.6	652	.068	.078
September	8	4	6.60	393	.042	.047
October	4	.5	2.71	167	.017	.020
November	.5	.5	.50	30	.0032	.0036
The period				2,140		
1904.						
April 18–30	17	4	12.0	309	.076	.037
May	42	10	28.5	1,752	.182	.210
June	500	35	182	10,830	1.16	1.29
July	62	10	36.2	2,226	.231	.266
August	10	1.5	4.03	248	.026	.030
September	8	2.5	5.46	325	.035	.039
October	6	1.5	4.62	284	.029	.033
November	2.5	1.0	1.33	79	.0085	.0095
The period				16,050		

BELLE FOURCHE RIVER AT BELLE FOURCHE, S. DAK.

This station was established May 26, 1903, by R. F. Walter. It is located at the county highway bridge on the western outskirts of Belle Fourche, S. Dak. The gage consists of a 2 by 4 inch vertical timber spiked to a pile on the north side of the bridge on the third bent from the east end. It is graduated to feet and tenths. The footmarks are copper figures and the tenths are marked with brass tacks. The gage is read twice each day by Raymond Giles. Discharge measurements are made from the north side of the bridge. The initial point for soundings is the center of the north pile in the first bent on the east side. The channel is straight for about 225 feet above the station and for 300 feet below. The current is swift. The left bank is high, with a few scattered trees. The right bank is low and subject to overflow at flood stages. It is sparsely wooded. The bed of the stream is of gravel and is permanent. The water flows in a single channel except at low stages, when it is divided by a gravel bar below

The preceding table is applicable only for open-channel conditions. It is based upon 24 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.10 feet and 6 feet. The table has been extended beyond these limits. Above gage height 3.30 feet the rating curve is a tangent, the difference being 70 per tenth. It is the same as the 1903 table above 3.0 feet.

Estimated monthly discharge of Belle Fourche River at Belle Fourche, S. Dak., for 1904.

[Drainage area, 3,250 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 11–31[a]	1,825	206	803	33,450	0.247	0.193
April	505	137	277	16,480	.085	.095
May	1,615	147	373	22,930	.115	.133
June	5,941	211	1,495	88,960	.460	.513
July	317	61	148	9,100	.046	.053
August	104	15	38.3	2,355	.012	.014
September	158	45	67.1	3,993	.021	.023
October	775	45	102	6,272	.031	.036
November	79	56	67.8	4,034	.021	.023
December[b]	104	59	77.2	4,747	.024	.028
The period				192,300		

[a] Ice January 1 to March 10.
[b] Ice December 20–31; discharge applied as for open channel.

RED WATER RIVER AT BELLE FOURCHE, S. DAK.

This station was established July 20, 1903, by R. F. Walter. It is located at the county highway bridge in the eastern limits of Belle Fourche, S. Dak. The gage consists of a 2 by 4 inch timber spiked to the west pile of the middle bent of the highway bridge. It is read twice each day by Raymond Giles. Discharge measurements are made from the west side of the bridge. The initial point for soundings is the center of the pile on the west side and at the south end of the bridge. The channel is straight for 50 feet above and below the station and the current is swift. The left bank is high enough to prevent overflow on that side. The right bank, however, is low and subject to overflow. There are trees along both banks. The bed of the stream is rocky and the channel permanent. The water flows in one channel. At very high stages the gage height may be affected by back water from Belle Fourche River. There is considerable "dead water" below the station. Bench mark No. 1 is on the stone water table at the northeast corner of the public school building. Its elevation above the zero of the gage is 26.05 feet. Bench mark No. 2

is the top of the hydrant 75 feet northwest of the public school building. Its elevation above the zero of the gage is 21.83 feet. Bench mark No. 3 is the top point on a stone monument near above-mentioned hydrant. Its elevation is 19.46 feet above the zero of the gage. A United States Geological Survey bench mark in the court-house yard is 3,011.345 feet above mean sea level and is 18.46 feet above zero of gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Red Water River at Belle Fourche, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 22	F. M. Madden	45	143	1.31	3.00	188
March 28	do	45	143	1.31	3.00	188
April 13	do	46	150	1.49	3.15	224
May 13[a]	do	70	70	1.61	2.70	113
June 3	F. C. Magruder	59	169	2.64	3.60	447
June 5	do	90	752	4.90	9.50	7,000
June 6	do	80	578	7.00	7.55	4,044
June 10	do	71	370	3.98	5.00	1,472
June 13	F. M. Madden	70	326	2.23	4.20	726
June 30	do	66	232	1.28	3.40	297
July 20	do	62	188	.60	2.75	113
July 20[a]	do	42	55	1.35	2.55	74
August 30[a]	do	44	76	2.17	2.90	165

[a] Wading at different sections.

Mean daily gage height, in feet, of Red Water River at Belle Fourche, S. Dak., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				3.02	3.0	2.95	3.4	2.5	2.8	2.95	3.1	3.05
2				3.02	3.0	3.15	3.38	2.5	3.18	2.95	3.1	3.05
3				2.92	3.0	3.5	3.5	2.5	3.05	2.95	3.1	3.05
4				2.98	2.9	5.7	3.32	2.5	3.0	2.95	3.0	3.0
5				2.95	2.78	10.2	3.2	2.5	3.0	2.95	3.0	3.0
6				3.1	2.75	7.4	3.2	2.45	2.95	2.95	3.0	3.0
7				3.2	2.75	5.7	3.2	2.45	2.98	2.95	3.0	3.0
8				3.2	2.7	5.42	3.15	2.5	3.0	2.98	3.0	3.0
9				3.2	2.7	5.42	3.1	2.58	3.0	3.0	3.0	3.0
10			[b]3.2	3.25	2.65	5.0	3.0	2.5	3.0	3.0	3.0	3.05
11			3.2	3.2	2.68	4.58	3.05	2.45	2.9	3.0	3.0	3.05
12			3.2	3.2	2.65	4.42	3.0	2.5	2.95	3.0	3.0	3.05
13			3.2	3.2	2.7	4.25	3.0	2.45	3.0	3.6	3.0	3.05
14			3.2	3.2	2.65	4.1	3.0	2.65	3.0	3.45	3.0	3.05
15			3.1	3.2	2.65	4.02	2.95	2.65	2.98	3.1	3.02	3.05

[a] Ice January 1 to March 9, inclusive.
[b] Gage heights estimated, March 10 to 13, inclusive.

The observations at this station, during 1904, have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Spearfish Creek near Spearfish, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
March 30	F. M. Madden	26	21	3.43	0.75	72
April 14	do	26	32	4.00	1.00	128
May 25	do	36	36	4.14	1.10	149
June 17	do	28	51	5.71	1.55	291
August 3	do	20	25	3.60	1.00	90
September 15	do	24	24	3.33	1.00	80

Mean daily gage height, in feet, of Spearfish Creek near Spearfish, S. Dak., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.75	1.1	1.1	1.25	1.05	1.05	1.0	0.95	0.95
2		.75	1.05	1.15	1.25	1.0	1.05	1.0	.95	.95
3		.75	1.05	1.25	1.35	1.0	1.05	.95	.95	.95
4		.8	1.05	6.35	1.25	.95	1.0	.95	.95	.95
5		.85	1.05	6.0	1.25	.95	.95	1.0	.95	.95
6		.9	1.05	2.2	1.25	.95	1.0	1.0	.95	.95
7		.9	1.05	2.2	1.25	.95	1.0	1.0	.95	.95
8		.85	1.05	2.15	1.15	.95	1.0	1.0	.95	.95
9		.8	1.05	2.2	1.15	.95	1.0	1.0	.95	.95
10		.85	1.05	2.05	1.15	.95	1.05	1.0	.95	.95
11		.9	1.05	1.85	1.15	.95	1.05	1.0	.95	.95
12		.9	1.05	1.8	1.15	.95	1.0	1.0	.95	.95
13		.9	1.05	1.75	1.15	.95	1.0	1.05	.95	1.0
14		1.0	1.05	1.75	1.15	.95	1.0	1.05	.95	1.0
15		1.05	1.05	1.7	1.15	.95	1.0	1.05	.95	1.0
16		1.0	1.05	1.55	1.1	.95	1.0	1.05	.95	.95
17		.95	1.00	1.55	1.05	.95	1.0	1.05	.95	.95
18		.95	1.00	1.5	1.05	.95	1.0	1.0	.95	.95
19		.95	.95	1.5	1.05	.95	1.0	1.0	.95	.95
20		.95	.95	1.5	1.05	.95	1.0	1.0	.95	.95
21		1.05	1.05	1.45	1.05	.95	.95	1.0	.95	.95
22		1.1	1.05	1.4	1.05	.95	.95	1.0	.95	.9
23		1.05	1.1	1.35	1.05	.95	.95	.95	.95	.9
24		1.05	1.15	1.45	1.05	.95	.95	.95	1.0	.9
25		1.0	1.15	1.35	1.05	.95	.95	.95	1.0	.8
26		1.0	1.15	1.35	1.05	.95	.95	.95	.95	.75
27		1.05	1.1	1.3	1.05	.95	.95	.95	.95	.8
28		1.05	1.05	1.25	1.05	.95	.95	.95	.95	a1.05
29		1.1	1.05	1.8	1.05	.95	.95	.95	.95	1.05
30	0.75	1.1	1.05	1.25	1.05	.95	.95	.95	.95	1.0
31	.75		1.05		1.05	.95		.95		.95

a Ice gorge December 28 to 31.

Rating table for Spearfish Creek near Spearfish, S. Dak., from January 1 to June 30, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Foot.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	61	1.00	125	1.60	306	2.10	514
.75	70	1.10	149	1.70	344	2.20	558
.80	80	1.20	175	1.80	384	2.30	604
.85	91	1.30	203	1.90	426	2.40	652
.90	102	1.40	235	2.00	470	2.50	700
.95	113	1.50	270				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is well defined between gage heights 0.75 foot and 1.55 feet. The table has been extended beyond these limits. A change in channel because of the formation of a gravel bar at the station necessitates new rating curve from July to December.

Rating table for Spearfish Creek near Spearfish, S. Dak., from July 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Foot.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	50	0.95	75	1.10	105	1.30	150
.85	57	1.00	85	1.20	127	1.40	178
.90	65						

The above table is applicable only for open-channel conditions. It is based upon 2 discharge measurements made during 1904, and is drawn parallel to the curve for the first part of the year. Discharges for this period are only roughly approximate.

Estimated monthly discharge of Spearfish Creek near Spearfish, S. Dak., for 1904.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	149	70	112	6,664	0.487	0.543
May	162	113	138	8,485	.600	.692
June	4,150	149	550	32,730	2.39	2.67
July	164	95	111	6,825	.483	.557
August	95	75	76.3	4,692	.332	.383
September	95	75	83.0	4,939	.361	.403
October	95	75	83.1	5,110	.361	.416
November	85	75	75.7	4,504	.329	.367
December [a]	85	44	69.2	4,255	.301	.347
The period				78,200		

[a] Discharge from December 28 to 31, assumed 50 second-feet.

OWL CREEK NEAR BELLE FOURCHE, S. DAK.

This station was established May 6, 1904, by F. M. Madden as a flood water station. It is located at the highway bridge, about 2 miles below the proposed Owl Creek reservoir, Belle Fourche project, 12 miles northeast of Belle Fourche, S. Dak. The gage is a plain, vertical staff, spiked to a pile at the downstream side of the bridge. The gage is read only at the time of making discharge measurements. Discharge measurements are made by wading or from the bridge to which the gage is attached. The initial point for soundings is a spike driven into the downstream end of the cap of the right abutment. The channel is straight for about 50 feet above and 200 feet below the station, and the current is swift. Both banks are high, and overflow only during extremely high stages. The slopes of the banks are lined almost to the bottom of the channel with brush. The bed of the stream is composed of soft mud, free from vegetation, and is permanent. There is but one channel, broken at high stages by the piling piers of the bridge. Bench mark No. 1 is a United States Geological Survey standard bench-mark post along the road, about 400 feet to the left of the stream. Its elevation is 2,933 feet above mean sea level and 67.62 feet above the zero of the gage. Bench mark No. 2 is a railroad spike driven into the base of a cottonwood tree, about 150 feet below the bridge, on the right bank of the stream. Its elevation is 15.91 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Owl Creek near Belle Fourche, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 6	F. M. Madden	5	1.8	0.94	0.50	1.7
May 25[a]	F. C. Magruder	53	352	3.16	8.80	1,114
May 26[a]	do	38	207	2.71	5.70	561
June 1	F. M. Madden	8	3.6	2.36	.95	8.5

[a] Float measurement.

RED WATER CANAL AT MINNESELA, S. DAK.

This station was established May 7, 1904, by F. M. Madden for determining the duty of water under this canal. It is located on the bridge across the canal in the town of Minnesela, about 4 miles southeast of Belle Fourche. A vertical staff gage, graduated to feet and tenths, is fastened to the bridge. It is read twice each day by Robert Mitchell. Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is a spike in the bridge over the edge of the canal at the right bank, downstream side. The channel is straight for about 200 feet above and

below the station. The current is medium. The bed of the stream is composed of soft mud, covered with water grass, which in the late summer lessens the flow of the canal considerably. There is but one channel at all stages. The bench mark is a spike in the base of a tree on the left bank of the canal, about 50 feet from the gage. Its elevation is 4.06 feet below the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Red Water canal at Minnesela, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 7	F. M. Madden	17	28	1.46	2.70	41
May 28	do	17	37	1.92	3.15	71
July 5	do	17	33	1.82	3.00	60
September 12 [a]	do	16	31	1.48	3.00	46

[a] Grass grown in canal.

Mean daily gage height, in feet, of Red Water canal at Minnesela, S. Dak., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	3.08	2.5	3.5	2.6	2.7
2	.....	2.58	2.6	3.5	2.6	2.75
3	.....	2.0	2.45	3.5	2.6	2.7
4	.....	2.0	2.75	3.5	2.7	2.65
5	.....	2.0	3.02	3.5	2.7	2.65
6	.....	2.0	3.05	3.5	2.7	2.6
7	.....	2.0	3.05	3.5	3.0	2.6
8	[a] 2.75	2.0	3.05	3.3	3.3	2.58
9	2.7	1.8	3.05	3.5	3.5	2.45
10	2.7	1.65	3.05	3.5	3.0	2.4
11	2.78	(b)	3.05	3.5	2.85	2.0
12	2.78	(b)	3.05	3.5	2.75	(c)
13	2.65	(b)	3.05	3.5	2.7	.....
14	2.62	(b)	3.05	3.5	2.65	.....
15	2.68	(b)	3.05	3.5	2.65	.....
16	2.65	(b)	3.05	3.5	2.9	.....
17	2.58	1.5	3.05	3.5	2.8	.....
18	2.7	1.65	3.02	3.5	2.7	.....
19	2.68	2.65	2.95	3.35	1.75	.....
20	2.72	2.8	2.85	3.2	1.8	.....
21	2.58	2.8	2.98	3.2	1.7	.....
22	2.92	2.8	3.18	3.2	1.65	.....
23	3.1	2.75	3.2	3.2	2.05	.....
24	3.1	2.7	3.12	3.2	2.1	.....
25	3.2	2.8	3.15	3.35	2.1	.....
26	3.2	2.8	3.1	3.5	2.2	.....
27	3.28	2.5	2.55	3.5	2.2	.....
28	3.1	2.5	2.62	3.5	2.25	.....
29	3.1	2.5	3.4	3.45	2.32	.....
30	3.1	2.5	3.4	3.4	2.5	.....
31	3.1	.....	3.3	3.4	.....	.....

[a] Water turned into canal for irrigation.
[b] Water turned out of canal on account of break. No appreciable discharge below 1.50 gage.
[c] Water turned out of canal for season.

CROW CREEK NEAR BELLE FOURCHE, S. DAK.

This station was established May 5, 1904, by F. M. Madden as a flood station. It is located at the highway bridge on the Camp Crook road, about 2½ miles north of Belle Fourche, S. Dak. A plain vertical staff gage is driven into the bed of the stream and the upper end is attached to a tree, a short distance below the bridge on the left bank. It is read only at the time of making discharge measurements. Discharge measurements are made from the bridge or by wading when the water is low. The initial point for soundings is a large spike driven into the downstream hand rail directly over the right pile bent. It is numbered 20 to avoid the minus sign in high water ratings. The channel is straight for about 50 feet above and 100 feet below the station, and the current is quite swift when the water is running. The right bank is high, and does not overflow. The left bank is of medium height, and overflows during high water. The slopes of both banks have some brush growing upon them. The bed of the stream is composed of soft, thick clay formed by decomposed shale, and is permanent. Bench mark No. 1 is a railroad spike driven near the base of a tree on the left bank, about 70 feet downstream from the bridge and 20 feet from the center of the channel. Its elevation is 11.83 feet above the zero of the gage. Bench mark No. 2 is a railroad spike near the base of a tree on the right bank, about 25 feet downstream from the bridge and 20 feet from the center of the channel. Its elevation is 14.95 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrogapher.

Discharge measurements of Crow Creek near Belle Fourche, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 3	F. C. Magruder	27	118	2.86	6.75	338
June 5	do	38	249	3.51	10.85	874

INDIAN CREEK NEAR BELLE FOURCHE, S. DAK.

This station was established May 6, 1904, by F. M. Madden as a flood station. It is located at the highway bridge near Ross's ranch, on the road through Owl Creek reservoir site, Belle Fourche project, and across Owl Creek, about 20 miles northeast of Belle Fourche, S. Dak. The gage is a plain vertical staff, graduated to feet and tenths, in two sections. The lower section is driven into the bed of the stream, projecting about 2 feet, and the upper section is spiked to a pile of the bridge. The gage is read during flood stages, when it is possible to get an observer. Discharge measurements are made by

wading, or from the bridge to which the gage is attached. The initial point for soundings is a spike driven into the right end of the downstream hand rail. The channel is straight for about 40 feet above and 150 feet below the station. The current is sluggish. Both banks are low, covered with a dense growth of brush and occasional trees, and subject to overflow. The bed of the stream is composed of mud, free from vegetation in the bottom of the channel, and is permanent. There is but little water flowing except at flood stages. Bench mark No. 1 is a railroad spike driven into the side of a stump toward the bridge, about 2 feet above the ground, on the right bank, 200 feet above the bridge, near the fence along the road. Its elevation is 11.65 feet above the zero of the gage. Bench mark No. 2 is a railroad spike driven near the base of a tree on the left bank, about 100 feet below the bridge. Its elevation is 13.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of Indian Creek near Belle Fourche, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 5	F. M. Madden	9	2.7	0.74	3.0	2.0
May 26[a]	F. C. Magruder	46	20.1	1.18	9.5	23.7

[a] Float measurement.

Mean daily gage height, in feet, of Indian Creek near Belle Fourche, S. Dak., for 1904.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1			12		5.50	23		
2			13		3.88	24		4.00
3			14		3.12	25		3.88
4		10.75	15		3.00	26	8.75	3.12
5		13.75	16			27	5.25	
6		14.75	17			28	3.50	
7		10.75	18			29	3.50	
8		9.25	19			30	3.00	
9		12.00	20			31	3.00	
10		13.88	21					
11		8.62	22					

NOTE.—No water running except on dates when gage height is given.

WHITE RIVER NEAR INTERIOR, S. DAK.

This station was established June 24, 1904, by F. M. Madden. It is located at the ford, about one-fourth mile northeast of Interior, S. Dak. An inclined gage, in two sections, is attached to posts set into the bed of the stream, at edge of bank, and into left bank of the stream. The inclined gage is graduated to read direct to feet and

tenths, and is read once each day by George L. Johnson. Discharge measurements are made by wading at the gage. The initial point for soundings is a spike holding the upper end of the gage to a cottonwood stump. The channel is curved for about 1,000 feet above and 500 feet below the station, and the current is sluggish. Both banks are high, clean, and do not overflow. The bed of the stream is composed of sand and gravel, and is shifting in character. There is but one channel at all stages, except very low water, when there may be several. The slope at the station is about 3 feet per mile. Bench mark No. 1 is a large spike driven into a blaze on a cottonwood tree 30 feet upstream from the gage, on the left bank. Its elevation is 10.41 feet above the zero of the gage. Bench mark No. 2 is a large spike driven into a blaze on a cottonwood tree on the left bank, 50 feet upstream from the gage. Its elevation is 10.26 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of R. F. Walter, resident hydrographer.

Discharge measurements of White River near Interior, S. Dak., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 24	F. M. Madden	112	56	1.41	1.90	79
August 11[a]	do	16	7.9	1.20	1.55	9.5
September 21[a]	do	15	5.8	.81	1.55	4.7

[a] At different sections.

Mean daily gage height, in feet, of White River near Interior, S. Dak., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.75	1.6	6.5	1.7	1.65
2		1.7	1.6	4.1	1.7	1.65
3		2.5	1.6	2.8	1.7	1.5
4		3.0	1.9	2.1	1.6	1.5
5		2.3	1.7	2.0	1.9	1.5
6		4.3	1.9	2.2	1.7	1.5
7		3.7	1.85	2.2	1.8	1.5
8		2.45	1.7	2.3	1.7	1.5
9		2.4	1.6	2.0	1.7	1.6
10		2.3	1.6	1.9	1.7	1.6
11		2.4	1.55	1.8	1.7	1.7
12		3.1	1.5	1.8	1.7	1.8
13		3.1	1.5	1.7	2.3	1.75
14		3.2	1.5	1.7	1.9	1.8
15		2.7	1.4	1.6	1.9	1.8
16		2.1	1.4	1.6	1.9	1.85
17		2.1	2.15	1.6	1.85	1.9
18		2.6	2.5	1.6	1.85	1.9
19		2.0	1.95	1.6	1.8	1.9

Mean daily gage height, in feet, of White River near Interior, S. Dak., for 1904—Continued.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
20		2.0	1.8	1.6	1.8	1.85
21		2.4	1.6	1.55	1.8	1.9
22		2.2	1.5	1.55	1.8	1.9
23		2.0	1.4	1.6	1.75	1.9
24	1.9	1.8	1.3	1.6	1.7	1.9
25	1.9	2.2	1.25	1.6	1.7	1.95
26	1.9	1.8	1.2	1.7	1.7	1.95
27	1.85	1.7	1.15	1.6	1.7	1.9
28	1.8	1.7	1.1	1.6	1.7	1.85
29	1.7	1.7	1.2	1.6	1.7	1.8
30	1.7	1.8	2.3	1.6	1.7	1.8
31		1.7	2.1		1.65	

NIOBRARA RIVER NEAR VALENTINE, NEBR.

This station was established July 22, 1897, by O. V. P. Stout, and was known as the Fort Niobrara station. On June 26, 1901, it was moved to the Borman Bridge, which is about 3 miles farther upstream. The gage is of the wire and weight type, located about 1,000 feet upstream from the bridge on the left bank. The wire runs over a pulley supported by a frame, on the arm of which the gage heights are read from a scale graduated to half tenths. The distance from the end of the weight to the index or marker on the wire is 9.90 feet. Measurements are made from a one-span steel bridge resting on tubular concrete piers, none of which obstruct the channel. The upstream hand rail is marked at 10-foot intervals, and the initial point for soundings is the zero mark on the upstream hand rail in line with the west face of the east pier. The channel is straight for about 100 feet both above and below the gaging section. The banks are high and not liable to overflow, while the bed is rock, covered at times with a thin layer of shifting sand. The velocity of the water is always very high. The range of gage heights seldom exceeds 1 foot, and the stream has a marked constancy of flow. In spite of the fact that conditions at this station are above the average in their approach to the ideal, it has been difficult to find a stable relation between gage height and discharge. Individual measurements, as determined by a series of duplicate gagings, can be made with a high degree of accuracy, yet it has been necessary to resort to the method of applying corrections to gage heights as outlined in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, et seq., in the preparation of tables of daily discharge. Bench mark No. 1 is the head of a nail driven in the stump of a box-elder tree—one of a clump of four—just east of Mr. Borman's house. Its elevation above gage datum is 17.26 feet. Bench mark No. 2 is a 6 by 6 inch pine head block, on which the gate rests when closed. Its elevation is 16.19 feet above gage datum.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Niobrara River near Valentine, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
April 17	J. C. Stevens	120	179	3.82	1.57	683
April 17	do	117	178	3.60	1.57	640
July 11	do	115	197	3.86	1.44	761
July 11	do	115	197	4.07	1.53	801
July 11	do	115	189	4.02	1.47	760
July 11	do	115	184	4.09	1.51	752
July 11	do	114	194	3.90	1.48	756
August 11	do	110	159	3.67	1.26	584
August 24	do	110	169	3.77	1.30	638

Mean daily gage height, in feet, of Niobrara River near Valentine, Nebr., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.65	2.30	2.05	1.56	1.55	1.86	1.35	1.30	1.54	1.51	1.55	1.54
2	1.74	2.25	1.90	1.53	1.60	1.78	1.35	1.60	1.36	1.50	1.52	1.51
3	1.63	2.35	1.55	1.55	1.55	2.05	1.37	1.33	1.37	1.55	1.53	1.50
4	1.67	2.15	1.80	1.57	1.75	1.85	1.40	1.40	1.49	1.53	1.55	1.58
5	1.68	2.25	1.75	1.60	1.70	1.58	1.92	1.38	1.50	1.52	1.54	1.51
6	1.75	2.40	2.02	1.56	1.65	1.55	1.50	1.40	1.38	1.45	1.57	1.56
7	1.80	1.95	1.87	1.58	1.57	1.55	1.80	1.32	1.40	1.36	1.55	1.65
8	1.80	1.82	1.80	1.60	1.72	1.85	1.53	1.30	1.39	1.38	1.52	1.64
9	1.76	1.80	1.70	1.56	1.60	2.30	1.42	1.31	1.37	1.42	1.56	1.60
10	1.73	1.95	1.78	1.60	1.56	1.60	1.40	1.30	1.34	1.47	1.60	1.66
11	1.70	1.83	1.67	1.60	1.52	1.61	1.55	1.25	1.36	1.48	1.58	1.61
12	1.74	1.96	1.65	1.55	1.72	1.57	1.47	1.29	1.35	1.45	1.55	1.55
13	1.73	2.36	1.60	1.56	1.60	1.55	1.45	1.30	1.35	1.46	1.54	1.56
14	1.74	2.32	1.62	1.60	1.55	1.45	1.42	1.35	1.25	1.43	1.52	1.67
15	1.75	1.96	1.58	1.58	1.51	1.54	1.42	1.24	1.30	1.41	1.55	1.60
16	1.71	2.00	1.60	1.58	1.52	1.50	1.31	1.30	1.26	1.48	1.53	1.71
17	1.70	2.28	1.60	1.58	1.49	1.42	1.32	1.35	1.28	1.43	1.52	1.65
18	1.75	2.20	1.57	1.55	1.51	1.40	1.30	1.33	1.30	1.62	1.56	1.72
19	1.66	2.25	1.55	1.50	1.48	1.47	1.31	1.44	1.36	1.63	1.57	1.57
20	1.61	2.32	1.55	1.49	1.50	1.70	1.26	1.40	1.35	1.55	1.52	1.64
21	1.56	2.31	1.58	1.53	1.52	1.46	1.37	1.36	1.26	1.54	1.58	1.72
22	1.60	2.40	1.50	1.62	1.50	1.42	1.32	1.34	1.30	1.56	1.51	1.78
23	1.61	2.42	1.41	1.55	1.52	1.45	1.30	1.30	1.32	1.54	1.54	1.74
24	1.40	2.20	1.52	1.63	1.50	1.35	1.23	1.31	1.33	1.54	1.53	1.77
25	.95	2.15	1.53	1.60	1.51	1.51	1.32	1.27	1.36	1.53	1.48	1.72
26	1.45	2.20	1.39	1.58	1.45	1.41	1.27	1.25	1.35	1.51	1.54	1.10
27	1.72	2.23	1.52	1.61	1.47	1.35	1.34	1.26	1.37	1.50	1.53	1.40
28	2.15	2.32	1.58	1.50	1.45	1.36	1.37	1.35	1.42	1.55	1.60	1.85
29	2.25	2.15	1.60	1.57	1.45	1.38	1.30	1.35	1.40	1.57	1.51	1.75
30	2.20	.....	1.55	1.55	1.46	1.36	1.35	1.32	1.45	1.58	1.56	1.30
31	2.55	.....	1.62	.....	1.48	.....	1.32	1.34	.....	1.54	.....	2.20

Mean daily discharge,[a] in second-feet, of Niobrara River near Valentine, Nebr., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	615	600	600	655	700	1,155	615	615	805	750	805	805
2	700	600	865	655	750	1,075	615	930	615	750	750	750
3	615	600	550	655	700	1,525	615	655	615	805	805	750
4	615	600	750	655	980	1,155	655	700	750	805	806	865
5	655	600	700	700	865	805	1,330	700	750	750	805	865
6	700	600	1,000	655	805	750	750	700	655	700	805	805
7	750	600	865	700	700	750	1,155	615	655	615	806	865
8	750	750	806	700	865	1,155	805	615	655	655	750	930
9	700	750	615	655	750	2,115	655	615	615	655	805	865
10	700	930	865	700	655	805	655	615	615	700	865	930
11	655	805	700	700	655	805	805	580	615	750	865	865
12	700	930	700	655	865	750	700	615	615	700	805	805
13	700	600	655	655	750	750	700	615	615	700	805	805
14	700	600	655	700	700	655	655	655	550	700	750	930
15	700	600	700	700	655	750	655	580	580	655	805	865
16	655	600	700	700	655	700	580	615	550	750	805	800
17	655	600	700	700	655	615	580	700	580	700	750	800
18	700	600	655	655	655	615	580	700	580	865	806	800
19	615	600	655	615	655	655	580	750	615	930	805	800
20	580	600	655	615	655	930	550	700	615	805	750	800
21	550	600	700	655	655	655	615	655	550	805	865	800
22	580	600	615	700	655	615	580	655	580	805	750	800
23	580	600	550	655	655	655	580	615	580	805	805	800
24	490	600	615	750	655	615	550	615	615	805	805	800
25	450	600	655	700	655	750	580	580	615	805	750	800
26	505	600	550	700	655	655	580	580	615	750	805	800
27	655	800	615	700	655	615	655	580	615	750	806	800
28	600	600	700	615	655	615	655	615	655	805	865	800
29	600	600	700	655	655	655	615	615	655	805	805	800
30	600	.....	655	655	656	615	655	580	700	865	805	800
31	600	.....	700	.....	700	.....	615	615	.....	805	.....	800

[a] The daily discharges were obtained by the indirect method outlined in the Nineteenth Annual Report United States Geological Survey. Pt. iv, p. 323, *et seq.*

Estimated monthly discharge of Niobrara River near Valentine, Nebr., for 1904.

[Drainage area, 6,070 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	750	450	634	38,980	0.104	0.120
February	930	600	640	36,810	.105	.113
March	1,000	550	692	42,550	.114	.131
April	750	615	674	40,110	.111	.124
May	930	655	705	43,350	.116	.134
June	2,115	615	832	49,510	.137	.153
July	1,330	550	675	41,500	.111	.128
August	930	580	644	39,600	.106	.122
September	805	550	627	37,310	.103	.115
October	930	615	760	46,730	.125	.144
November	865	750	800	47,600	.132	.147
December	930	750	823	50,600	.136	.157
The year	2,115	450	709	514,600	.117	1.59

RED DEER LAKE NEAR WOODLAKE, NEBR.

This station was established August 12, 1904, by J. C. Stevens. The lake is located in sections 16, 17, 20, and 21, T. 30 N., R. 27 W., about 16 miles southwest of Woodlake post-office, and about 30 miles south of Valentine, Nebr., and is representative of the numerous lakes abounding in this region. It was established in order to determine the amount of periodic rises of these lakes and their probable cause, which, according to local authorities, is often several feet, beginning in April or May. A plain staff gage, graduated to feet and tenths, is fastened to a post at the end of the boat landing, 200 yards south of Cochran's ranch house near the east end of the lake. The gage is read once each week by J. S. Brosius. The lake covers about 1 square mile of surface and has a varying depth of from 1 to 15 feet—probably an average depth of 8 feet—and is only a valley or flat in the sand hills filled with water. Its bed is entirely of sand and the margin is thickly grown up with rushes, etc. The bench mark is a group of 3 spikes driven horizontally near the base of a cottonwood tree 12 inches in diameter, located 40 feet south and 20 feet east of the southwest corner post of the large windmill tower just west of Cochran's house. Its elevation is 9.61 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Mean daily gage height, in feet, of Red Deer Lake near Woodlake, Nebr., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1						17		3.50			4.34
2		4.6				18					
3					4.32	19	4.5			4.33	
4				4.32		20					
5						21			4.35		
6						22					
7			4.33			23		4.31			
8						24					4.32
9						25				4.32	
10		4.42			4.34	26					
11						27	4.32				
12				4.33		28			4.32		
13						29					
14			4.31			30		4.36			4.38
15						31					
16											

OSAGE[a] RIVER AT OTTAWA, KANS.

This station was established August 26, 1902, by W. G. Russell. It is located at the highway bridge near the center of the town of Ottawa, Kans. The gage is of the old wire type, with its scale spiked to the bridge floor. This gage was destroyed by the flood of May 30, 1904. A temporary gage was put in June 3, 1904, but which could not be referred to the bench mark as it was under water at that time. This gage was corrected by reference to the bench mark July 18, 1904, and all intermediate gage readings corrected. A new gage was put in September 9, 1904, as the water had left the temporary gage. This is a standard chain gage locked in a box on the outside of the hand rail on the downstream side of the bridge. This gage rod is 1 by 4 inches by 32 feet, painted white, bolted to the hand rail, and is graduated in feet and tenths from zero to 32 feet. It is read once each day by W. H. Blacksten. Discharge measurements are made from the highway bridge, to which the gage is attached. The bridge is somewhat oblique to the thread of the stream and has a total span between abutments of 135 feet. At low stages the discharge can be measured by wading at a short distance below the bridge. The channel is slightly curved and the current is swift. Both banks are high and the bed of the stream is rocky.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

[a] Known also as Marais des Cygnes.

Discharge measurements of Osage River at Ottawa, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 17	W. G. Russell	125	134	5.52	2.30	740
April 29	do	130	225	5.48	3.00	1,230
June 3	do	140	3,165	3.55	23.70	11,230
June 3	do	140	3,290	3.76	24.62	12,310
July 18	do	.....	217	2.04	2.18	443
September 10	do	86	88	1.26	1.60	111

Mean daily gage height, in feet, of Osage River at Ottawa, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	2.0	1.8	2.4	2.8	.....	8.3	1.7	1.4	1.5	1.1	1.3
2	1.9	2.0	1.8	2.3	2.6	.....	5.85	1.7	12.55	1.5	1.2	1.3
3	1.9	2.0	1.9	2.2	2.5	24.6	6.1	1.6	13.3	1.5	1.2	1.3
4	1.9	2.0	1.9	2.2	2.4	24.75	7.35	1.6	2.7	1.5	1.2	1.3
5	1.9	1.9	1.9	2.1	5.8	24.45	4.95	1.6	1.9	1.5	1.2	1.3
6	1.9	1.7	1.9	2.1	13.5	17.0	19.6	1.6	1.7	1.4	1.2	1.3
7	1.9	1.7	1.8	2.2	13.75	5.97	25.55	1.5	1.6	1.4	1.2	1.3
8	1.8	1.8	1.8	2.4	7.8	3.25	30.15	1.5	1.6	1.3	1.2	1.3
9	1.8	1.8	1.8	2.8	9.55	2.85	29.5	1.5	1.6	1.3	1.2	1.3
10	1.8	1.8	1.8	3.0	5.6	2.7	27.25	1.5	1.6	1.3	1.2	1.3
11	1.8	1.8	1.8	3.3	3.2	4.6	17.45	1.5	1.6	1.3	1.2	1.3
12	1.7	1.7	1.8	2.9	2.8	7.85	4.65	1.5	1.6	1.3	1.2	1.3
13	1.7	1.7	1.8	2.7	3.3	3.2	3.25	1.5	1.6	1.3	1.2	1.3
14	1.8	1.6	1.9	2.4	4.9	2.6	2.85	2.1	1.6	1.3	1.2	1.3
15	1.8	1.6	1.9	2.3	3.1	2.7	2.6	1.5	1.6	1.3	1.2	1.3
16	1.8	1.7	1.9	2.2	20.35	7.5	2.3	1.5	1.5	1.2	1.2	1.3
17	1.8	1.7	2.0	2.1	24.25	4.0	2.3	1.5	1.5	1.2	1.3	1.3
18	1.8	1.7	3.0	2.1	23.5	2.8	2.2	1.5	1.5	1.2	1.3	1.3
19	1.8	1.8	2.8	2.0	9.15	12.6	2.0	3.1	1.4	1.2	1.3	1.3
20	1.8	1.7	2.4	2.1	3.4	15.05	2.0	2.5	1.4	1.2	1.3	1.3
21	2.0	1.8	2.4	4.3	3.1	10.5	2.0	2.1	1.3	1.2	1.3	1.3
22	2.2	1.8	4.0	3.7	2.9	6.3	3.5	2.0	1.3	1.2	1.2	1.3
23	2.1	1.7	3.0	4.5	2.7	4.15	2.3	5.0	1.4	1.2	1.2	1.3
24	1.8	1.7	2.5	19.0	2.5	2.65	1.9	2.5	1.4	1.2	1.3	1.3
25	2.2	1.7	11.1	24.15	2.4	16.45	1.8	1.9	1.3	1.1	1.3	1.3
26	2.1	1.8	16.6	20.9	7.0	22.9	2.5	1.9	1.3	1.1	1.3	1.1
27	2.1	1.8	12.0	9.9	9.4	26.25	2.2	1.7	1.3	1.1	1.3	1.1
28	2.1	1.7	3.2	4.1	4.9	25.0	2.1	1.5	1.3	1.1	1.3	1.1
29	2.1	1.7	2.7	3.1	(b)	10.4	2.6	1.5	1.3	1.1	1.3	1.1
30	2.1	.....	2.6	2.7	31.8	8.3	1.9	1.5	1.4	1.1	1.3	1.2
31	2.1	.....	2.5	.....	.....	.....	1.8	1.4	.....	1.1	.....	1.3

GASCONADE RIVER NEAR ARLINGTON, MO.

This station was established April 11, 1903, by I. W. McConnell. It is located about 2 miles below Arlington, at the foot of the first bluff near the river on the right bank below the city. The gage is a

vertical 2 by 4 inch rod 16 feet long, fastened to a leaning willow tree. It was read once each day during 1904 by C. W. Harrison. Discharge measurements are made from a cable and boat, with distances marked on a tag wire. On account of the cable being washed away by floods an apparatus for raising and lowering the cable was established November 28, 1903. The elevation of the gage was verified at this time. The initial point for soundings is a blazed white-oak tree 50 feet up the bank from the gage in the line of the cross section. The bench mark to which the gage is referred is a cross on a rock near the same tree, and is at an elevation of 27.2 feet above the zero of the gage. The channel is straight for 500 feet above and 2,000 feet below the station. The current is swift. The right bank is high and wooded to the edge of the cliff, which rises for a vertical distance of 200 to 250 feet. The left bank is low, but not likely to be overflowed except at extreme flood stages. The bed of the stream is of gravel and bed rock, with occasional bowlders, and is not likely to shift. There is but one channel at all stages. At ordinary stages the water is about 10 feet deep.

Owing to the impossibility of maintaining a cable across the river during high water, this station was moved, August 11, 1904, to the St. Louis and San Francisco Railroad bridge, 1¼ miles upstream from the cable and one-fourth mile west of Arlington. This bridge is a three-span Pratt truss, having a total length of 431 feet between abutments. The channel is straight for about 1,000 feet above and below the bridge. There is a swift direct current. Both banks are fairly high and partially wooded, and are subject to overflow only during very high water. At all stages the water passes between the abutments of the bridge. The bed of the stream is composed of clean gravel and rock and is practically permanent. A regulation chain gage is used, having a length of weight and chain to the outside of the ring (which is used for marker) of 33.50 feet. The pulley center is 0.53 foot to the left of the zero of the gage. The zero of the gage is at 117.01 feet from the initial point for soundings, which is situated on the inner face of the right abutment. The bench mark is located on the top surface of a cap situated on the upstream lower chord just to the right of the fifth panel point from the right abutment. This is designated by a dent in the upper surface of the above-mentioned cap. Its elevation is 28.85 feet above the gage datum. The elevation above the zero of the gage of the pulley center is 32.75 feet.

The observations at this station during 1904 were under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Gasconade River near Arlington, Mo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 26	F. W. Hanna	295	2,277	2.08	6.49	4,734
March 7	do	264	1,496	1.14	3.75	1,713
April 11 [a]	do	410	2,415	3.32	8.00	8,025
April 27 [a]	do	410	4,029	4.20	11.70	16,910
June 14 [a b]	Hanna and Murphy	410	1,138	1.78	[b] 4.30	2,032
July 26 [c]	F. W. Hanna	294	1,006	1.39	3.55	1,403
August 11 [c]	do	269	847	1.02	3.10	864
September 27 [c]	Hanna and Johnson	269	835	.95	3.08	794
November 25 [c]	F. W. Hanna	236	709	.85	2.83	600

[a] Frisco Railroad bridge.
[b] Gage doubtful, as it was loosened by the flood.
[c] New gage with new gage-datum plane.

Mean daily gage height, in feet, of Gasconade River near Arlington, Mo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	4.1	4.5	9.0	6.9	4.5	8.5	3.3	3.2	3.3	2.7	2.8
2	2.9	3.8	4.1	9.0	6.4	4.3	6.5	3.2	3.3	3.35	2.75	2.85
3	2.9	3.8	4.1	8.0	6.0	4.2	6.0	3.2	3.3	3.3	2.7	2.8
4	2.9	3.85	4.0	8.0	5.8	9.3	6.5	3.1	3.2	3.15	2.65	2.7
5	2.7	3.7	3.9	7.0	5.7	10.0	6.7	3.1	3.2	3.1	2.65	2.7
6	2.6	3.6	3.8	6.05	5.7	10.1	6.4	3.0	3.1	3.05	2.65	2.6
7	2.5	3.6	3.6	6.0	5.8	10.0	5.7	2.9	3.0	3.0	2.65	2.65
8	2.5	3.55	3.6	8.0	5.9	7.0	5.4	2.8	3.1	3.0	2.7	2.6
9	2.5	3.5	4.6	9.05	6.4	6.5	5.5	3.1	3.0	2.95	2.75	2.65
10	2.5	3.5	4.6	9.05	5.8	5.5	4.9	2.9	3.0	3.0	2.8	2.85
11	2.5	3.5	4.6	8.0	5.6	5.5	4.7	2.9	3.0	2.9	2.75	2.85
12	2.5	3.4	4.6	7.5	5.5	4.8	4.4	[b] 2.85	2.95	2.95	2.7	2.9
13	2.5	3.3	4.6	6.8	5.3	4.5	4.2	2.9	3.0	2.95	2.6	2.85
14	2.5	3.2	4.5	6.4	5.0	4.3	4.0	3.0	3.2	2.9	2.6	2.85
15	2.5	3.1	3.9	6.0	4.8	4.1	3.9	3.1	3.55	2.9	2.6	2.8
16	2.5	3.1	3.8	5.9	4.8	4.5	3.7	3.15	3.2	2.9	2.65	2.8
17	2.5	3.05	3.9	6.5	4.8	4.3	3.5	3.1	3.1	2.9	2.65	2.85
18	2.5	3.0	4.0	5.9	5.5	4.2	3.5	3.0	3.0	2.9	2.6	2.85
19	2.4	2.9	4.1	5.2	5.4	4.5	3.5	3.1	3.4	2.9	2.7	2.9
20	2.4	2.9	4.1	5.1	5.0	6.3	3.4	3.3	3.35	2.9	2.7	2.95
21	10.7	3.3	4.2	5.9	4.05	5.3	3.3	3.2	3.1	2.95	2.65	2.85
22	10.7	3.8	4.2	7.1	4.3	5.0	3.2	3.8	3.1	2.9	2.6	2.85
23	11.5	3.9	4.2	7.2	4.2	6.0	3.2	4.65	3.1	2.8	2.6	2.85
24	10.5	3.9	4.5	(a)	4.2	5.3	3.1	4.95	3.1	2.8	2.6	2.85
25	7.7	4.1	5.5	(a)	4.2	5.2	3.0	5.0	3.1	2.8	2.9	2.95
26	6.4	4.5	16.5	18.0	5.0	14.5	3.5	4.1	3.05	2.8	2.85	2.95
27	6.3	4.9	(a)	14.2	4.4	14.0	3.4	3.85	3.0	2.8	2.85	2.90
28	5.3	4.8	(a)	10.5	4.0	14.3	3.4	3.6	3.05	2.85	2.8	2.90
29	5.0	4.7	(a)	8.3	6.0	10.0	3.3	3.5	3.0	2.8	2.8	2.85
30	4.7	.....	9.0	7.5	5.5	8.0	3.3	3.4	3.2	2.7	2.8	2.8
31	4.5	.....	9.0	.....	5.4	.....	3.2	3.3	.....	2.7	.....	2.85

[a] Over gage.
[b] Beginning August 12 the gage heights refer to the new datum of the chain gage established at the St. Louis and San Francisco Railroad bridge.

Rating table for Gasconade River near Arlington, Mo., from January 1, 1903, to August 11, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	815	4.00	1,930	5.60	3,920	8.40	8,890
2.40	849	4.10	2,041	5.70	4,055	8.60	9,326
2.50	885	4.20	2,155	5.80	4,191	8.80	9,762
2.60	923	4.30	2,271	5.90	4,328	9.00	10,200
2.70	963	4.40	2,390	6.00	4,467	9.50	11,350
2.80	1,006	4.50	2,510	6.20	4,751	10.00	12,550
2.90	1,052	4.60	2,632	6.40	5,051	10.50	13,800
3.00	1,100	4.70	2,755	6.60	5,367	11.00	15,090
3.10	1,152	4.80	2,879	6.80	5,699	11.50	16,390
3.20	1,210	4.90	3,004	7.00	6,047	12.00	17,740
3.30	1,276	5.00	3,130	7.20	6,411	13.00	20,440
3.40	1,349	5.10	3,258	7.40	6,790	14.00	23,140
3.50	1,430	5.20	3,388	7.60	7,184	15.00	25,840
3.60	1,519	5.30	3,519	7.80	7,594	16.00	28,540
3.70	1,615	5.40	3,651	8.00	8,018	17.00	31,240
3.80	1,716	5.50	3,785	8.20	8,454	18.00	33,940
3.90	1,821						

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.4 feet and 6.1 feet. The table has been extended beyond these limits. Above gage height 11.5 feet the rating curve is a tangent, the difference being 270 per tenth. On August 11, 1904, the station was changed to the St. Louis and San Francisco Railway bridge, and a gage with a new datum installed. Gagings on that and succeeding dates are not applicable to this curve.

Estimated monthly discharge of Gasconade River near Arlington, Mo., for 1904.

[Drainage area, 2,725 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	16,390	849	3,435	1.26	1.45
February	3,004	1,052	1,653	.607	.655
March, 28 days [a]	.....	1,519	3,757	1.38	1.44
April, 28 days [a]	.....	3,258	8,390	3.08	3.21
May	5,871	1,930	3,519	1.29	1.49
June	24,490	2,041	6,959	2.55	2.84
July	9,108	1,100	2,620	.961	1.11
August, 11 days [b]	1,276	1,006	1,129	.414	.169

[a] For three days in March and two in April the water was over the gage.
[b] August 12 the gage was changed to a new location with a new datum.

MISCELLANEOUS MEASUREMENTS IN MISSOURI RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in Missouri River drainage basin in 1904:

Miscellaneous measurements in the Missouri River drainage basin in South Dakota and Montana.

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
Mar. 30	Spearfish Creek	Spearfish, S. Dak	24	2.67		64
Apr. 14	Spearfish power flume	do	27	1.15		31
Apr. 15	Cottonwood Creek	Edgemont, S. Dak	.6	.67		.40
Apr. 18	Cheyenne River	Mouth of Fall River	58	1.21		70
Apr. 18	Fall River	At mouth	15	1.87		28
Apr. 18	Evans power flume	Hot Springs, S. Dak	18	2.33		42
Apr. 18	Irrigation ditch	¼ mile below Hot Springs	7.5	2.03		17
Apr. 26	Bad River	Near Midland, S. Dak	2.9	.55		1.6
Apr. 27	White River	Stearns, S. Dak	40	3.82		153
Apr. 30	Cheyenne River	Creston, S. Dak	33	1.70		56
Apr. 30	Rapid Creek	do	28	2.79		78
Apr. 30	Murphy ditch	Hewitt ranch on Rapid Creek, S. Dak.	8.1	2.47		20
May 14	Cottonwood Creek	Edgemont, S. Dak	3.1	.13		.4
May 18	Figel ditch	Rapid, S. Dak	2.2	.32		.7
May 21	Belle Fourche power canal.	Belle Fourche, S. Dak	15	2.00		30
May 26	Cottonwood Creek	Edgemont, S. Dak	31	3.10		94
June 1	Horse Creek	Bixby road, S. Dak	32	.37		12
June 3	Moreau River	Bixby, S. Dak	89	1.54		137
June 7	Rabbit Creek	Selm road, S. Dak	40	2.28		91
June 9	Main Fork Sulphur Creek.	Bixby road, S. Dak	154	1.88		290
July 5	Belle Fourche power canal.	Belle Fourche, S. Dak	14	1.21		17
July 14	North Fork Grand River	Selm, S. Dak	3	1.00		3
Aug. 3	Spearfish power flume	Spearfish, S. Dak	20	1.04		21
Aug. 3	Matthews & Son ditch	do	1.9	3.75		7.1
Aug. 3	Gregg & Matthews ditch	do	2.4	1.31		3.1
Aug. 3	Walton & Co. ditch	do	2.5	2.25		5.7
Aug. 3	Mann ditch	do	2.4	.52		1.2
Aug. 4	Eckles ditch	do	2.2	1.51		3.3
Aug. 4	Evans ditch	do	4	3.00		12
Aug. 4	Cooks ditch	do	12	3.08		37
Aug. 4	Toomeys ditch	do	4.4	1.16		5.1
Aug. 4	McGregors ditch	do	3.9	.94		3.7
Aug. 4	Bill Cook ditch	do	6.1	3.29		20
Aug. 4	Kemper & Dersey ditch	do	7.5	1.49		11.2
Aug. 4	Spearfish Creek	Below Spearfish, S. Dak	25	1.12		29
Aug. 9	Little Grant	Rapid, S. Dak	2.6	2.08		5.4
Aug. 9	Farmingdale ditch	do	2.6	1.78		4.5
Aug. 9	Rapid Creek	Creston, S. Dak	14	1.57		22
Aug. 9	Cheyenne River	do	30	1.60		48
Aug. 13	St. German ditch	Rapid, S. Dak	12	1.25		15
Aug. 13	Lone Tree ditch	do	14	1.50		21
Aug. 13	South ditch	do	8	1.75		14
Sept. 11	Missouri River	Great Falls, Mont	1,174	2.39		2,811
Sept. 11	Giant Springs	do	57	3.54		202

Miscellaneous measurements in the Missouri River drainage basin in South Dakota and Montana—Continued.

SUBDRAINAGE AREA OF MILK RIVER.

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 15	Milk River	Coutts, Mont	22	2.79	.....	[a] 62
Aug. 9	.....do	Yantic, Mont	3.8	.76	.....	2.9
Aug. 9	.....do	Chinook, Mont	4.3	.70	.....	3
Aug. 8	.....do	Zurich, Mont	3.5	.66	.....	2.3
Aug. 8	.....do	Fort Belknap Agency, Mont.	2.8	.70	.....	1.4
Aug. 6	.....do	Glasgow, Mont	9.3	2.96	.....	27.5
Aug. 9	West Fork Milk River	Chinook, Mont	(b)	(b)	.....	2
Apr. 8	Exeter Creek	Exeter, Mont	18	1.11	.....	20
Apr. 13	.....do	.....do	(b)	(b)	.....	1
Apr. 18	Alkali Creek	Malta, Mont	153	1.80	.....	[c] 275
Aug. 8	New Fort Belknap canal	Indian Agency	3.1	.64	2.15	[d] 2

SUBDRAINAGE AREA OF YELLOWSTONE RIVER.

July 26	Crow Agency ditch	Crow Agency, Mont	34	0.80	.....	[e] 27
July 26	Little Bighorn River	.....do	95	1.87	.....	[e] 179
Sept. 17	.....do	.....do	(b)	(b)	.....	250
Sept. 28	.....do	.....do	70	.93	.....	[e] 65

[a] Near head of Milk River canal of the Canadian Northwest Irrigation Company.
[b] Estimated.
[c] 1 mile above junction with Milk River.
[d] 150 feet below the canal head gates.
[e] Near head gates of Crow Agency ditch.

Streams tributary to Niobrara River in Nebraska.

Date.	Hydrographer.	Stream.	Locality.	Area.	Mean velocity.	Discharge.
				Sq. feet.	*Ft. per sec.*	*Sec.-feet.*
Aug. 19	J. C. Stevens	Bear Creek	Sec. 31, T. 34, R. 34	1	2.00	2
Aug. 16	.....do	Boardmans Creek	Sec. 1, T. 30, R. 31	6.8	1.07	7.3
Aug. 23	.....do	Deer Creek	Sec. 5, T. 30, R. 43	3.8	1.92	7.3
Aug. 13	.....do	Fairfield Creek	Sec. 31, T. 33, R. 23	16	1.34	21.5
July 13	.....do	Keya Paha River	Butte	92	2.22	204
Oct. 23	Adna Dobson	.....do	Sec. 24, R. 34, T. 16	.....	.....	78
Aug. 24	J. C. Stevens	Minnechaduza Creek	Valentine	14	1.50	21
July 13	.....do	Millrace	Electric power plant, Butte.	38	1.40	53
July 13	.....do	Niobrara River	Butte	430	6.53	2,808
Aug. 13	.....do	.....do	Sec. 31, T. 33, R. 23	285	2.64	752
Aug. 14	.....do	.....do	Sec. 26, T. 34, R. 26	203	3.34	679
Aug. 18	.....do	.....do	Sec. 10, T. 33, R. 34	84	2.63	221
Aug. 20	.....do	.....do	Sec. 11, T. 33, R. 36	101	1.98	200
Aug. 20	.....do	.....do	Sec. 27, T. 33, R. 37	42	4.33	180
Aug. 21	.....do	.....do	Sec. 34, T. 33, R. 38	51	2.29	117
Aug. 22	.....do	.....do	Sec. 24, T. 31, R. 42	35	1.54	54
Aug. 23	.....do	.....do	Sec. 18, T. 30, R. 43	21	1.30	27
Aug. 13	.....do	Plum Creek	Sec. 7, T. 31, R. 23	34	2.35	80
Aug. 23	.....do	Pine Creek	Sec. 22, T. 30, R. 44	13.6	.94	12.8
Aug. 22	.....do	Rush Creek	Sec. 32, T. 31, R. 42	.3	2.00	.6
Aug. 16	.....do	Snake River	Sec. 15, T. 32, R. 30	106	2.63	279
Aug. 16	.....do	.....do	Sec. 10, T. 30, R. 31	77	2.65	204
Aug. 17	.....do	.....do	Sec. 2, T. 30, R. 32	65	2.97	194
Oct. 27	.....do	.....do	Sec. 16, T. 31, R. 30	104	2.40	245
June 19	G. W. Bates	White Clay Creek	Sec. 36, T. 35, R. 45	.....	.....	11

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 130.]

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV,
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39. Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
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Author.

U. S. Geological survey.

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Reference.

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Water-Supply and Irrigation Paper No. 131 Series P, Hydrographic Progress Reports, 36

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

BY

M. C. HINDERLIDER and JOHN C. HOYT

PART VIII.—Platte, Kansas, Meramec, Arkansas, and Red River Drainages

WASHINGTON
GOVERNMENT PRINTING OFFICE
1905

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., April 26, 1905.

SIR: I transmit herewith the manuscript of Part VIII of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of district hydrographer M. C. Hinderlider, who was assisted by Messrs. R. I. Meeker, J. C. Stevens, A. J. Parshall, W. G. Russell, and F. M. Madden. A limited amount of the data was collected by other parties as noted in the list of acknowledgments. The assembling of the data and its preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, A. H. Horton, H. D. Comstock, F. H. Tillinghast, and H. M. Morse.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL,
Chief Engineer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART VIII.

By M. C. Hinderlider and John C. Hoyt.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	25,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
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Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

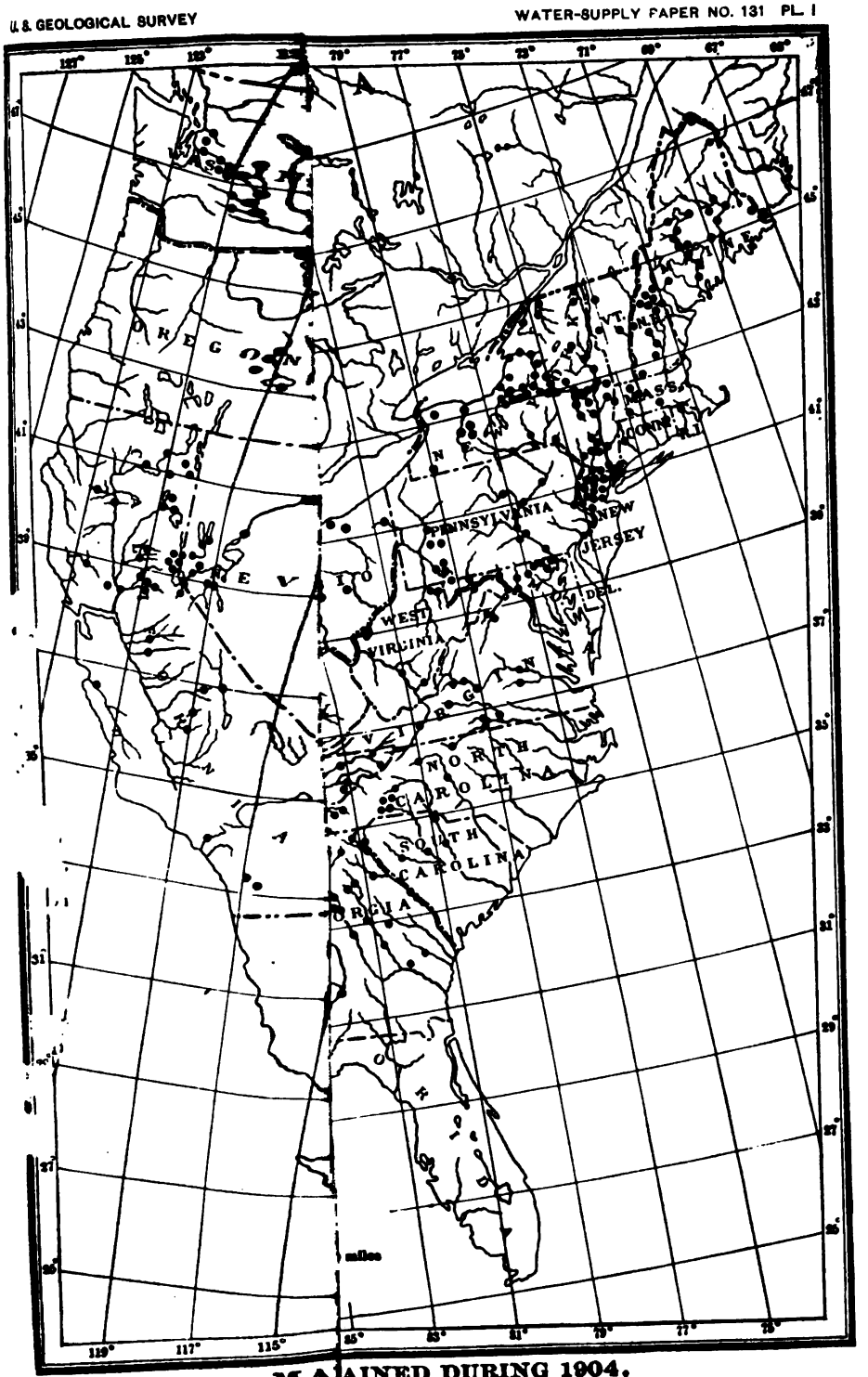
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view, gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage reading. From these two factors it is possible to estimate both the total flow and its distribution through the period of observation.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In some sections certain permanent stations are maintained for general statistical purposes to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations, and, second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station with car, tag line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tag line indicating the points of measurement. Where the current



MAINED DURING 1904.

swift some appliance, generally a secondary cable, is necessary to hold the meter below the surface.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. At stations with shifting beds more measurements are made, and special methods of computing daily discharges are employed. Great care is taken in the selection and equipment of gaging stations in order that the data may have the required degree of accuracy.

On many of the larger rivers, where water power is developed by dams, estimates of flow are obtained by observing the head on the

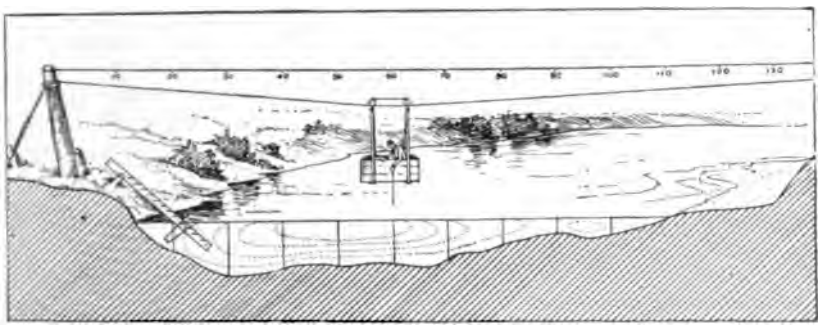


FIG. 1.—Cable station, showing section of river, car, gage, etc.

crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points

are usually at regular intervals varying from 2 to 20 feet, depending upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and soundings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between .94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from .85 to .95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity curve and the initial line. Owing to the length of time it takes to make these measurements they

PRICE CURRENT METERS, WITH BUZZERS.

are seldom used except for determining coefficients for purposes of comparison and for measurements under ice.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, 0.5 foot below the surface, and 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity, twice the mid-depth velocity, and the bottom velocity by 4.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in high-water measurement computations, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-

feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area, on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights. (2 and 3 depend on 1.)

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent, or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds the results of the discharge measurements are plotted on cross-section

paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared. Aside from plotting the discharge, the mean velocity and area determined for each discharge measurement are plotted. Through these points the curves of mean velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value to determine the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station-rating curve the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station-rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes take place.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are either taken by integration in verticals or by the vertical velocity-curve method, as sufficient experi-

ments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part VIII, is published in a series of twelve Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainage.
Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.
Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.
Part 5. Eastern Mississippi River drainage.
Part 6. Great Lakes and St. Lawrence River drainage.
Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.
Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.
Part 9. Western Gulf of Mexico drainage.
Part 10. Colorado River and the Great Basin drainages.
Part 11. The Great Basin and Pacific Ocean drainages in California.
Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations, and such other information that has been collected, that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns which are defined on page 14 are based.

In the computations for the tables of this report the following rules have been used in general:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications. A detailed index of these reports (1888–1903) is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Arkansas.—District hydrographer, M. R. Hall.[a]

Colorado.—District and resident hydrographer, M. C. Hinderlider,[b] assisted by R. I. Meeker, assistant engineer; Oro McDermith, Wm. A. Lamb, George B. Monk, and L. E. Foster, hydrographers; and Melvin Beeson, Thomas E. Brick, Theodore Tobish, and F. L. Meeker, office assistants. Acknowledgments are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, Union Pacific, Rio Grande Southern, and Atchison, Topeka and Santa Fe railroads for free transportation for hydrographers over their lines.

Kansas.—District hydrographer, M. C. Hinderlider, and resident hydrographer, W. G. Russell. Acknowledgments are due the Atchison, Topeka and Santa Fe, Union Pacific, Missouri, Kansas and Texas, and Chicago, Rock Island and Pacific railway companies for annual passes issued to Mr. Russell.

Missouri.—District hydrographer, E. Johnson, jr.,[c] assisted by F. W. Hanna, assistant engineer. Acknowledgment should be made to the St. Louis and San Francisco Railroad for transportation furnished to Mr. Hanna between St. Louis and Arlington, Mo., and to George B. Mainprize for voluntary observations at Greer Springs, Greer, Mo.

Nebraska.—District hydrographer, M. C. Hinderlider, and resident hydrographer, J. C. Stevens. Valuable assistance was rendered by Prof. O. V. P. Stout, of the University of Nebraska, in the way of the free use by the resident hydrographer of office facilities and suggestions in the methods for the collection of field data. Acknowledgments are also due the Chicago, Burlington and Quincy, Chicago and Northwestern, and Fremont, Elkhorn and Missouri Valley railroads for annual passes issued in favor of Mr. Stevens.

New Mexico.—The hydrographic work in the northern portion of this Territory was carried on under the direction of District Hydrographer M. C. Hinderlider, assisted as follows: The work in the north central portion was in charge of George B. Monk, assistant hydrographer; that in the extreme eastern portion was in charge of W. G. Russell, while the work in the northwestern portion was in charge of Robert C. Prewitt, field assistant. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on the Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of Lacueva, N. Mex.; also to James D. Hand, of Las Alamos, N. Mex., for similar favors. Transportation in the form of an annual pass was furnished Mr. Monk by the Denver and Rio Grande Railroad and to W. G. Russell by the Chicago, Rock Island and El Paso Railroad. For the purpose of collecting data in New Mexico during the later part of the year an annual pass over the Atchison, Topeka and Santa Fe Railway was issued to George B. Monk, for which acknowledgments are due.

[a] District hydrographer for Arkansas for 1905, T. U. Taylor, Austin, Tex.

[b] Office of district hydrographer for Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Indian Territories, and Wyoming, Chamber of Commerce Building, Denver, Colo.

[c] Office of district hydrographer for Missouri, 876 Federal Building, Chicago, Ill.

Oklahoma and Indian Territories.—The hydrographic work in the southern part of Oklahoma was carried on under the direction of G. H. Matthes, district engineer. The remainder of the work was carried on under district hydrographer M. C. Hinderlider by resident hydrographer, W. G. Russell. Acknowledgments are due the Atchison, Topeka and Santa Fe, Missouri, Kansas and Texas, and Chicago, Rock Island and Pacific railway companies for annual passes issued to Mr. Russell.

Wyoming.—The hydrographic work in this State has been carried on under the direction of the district hydrographer, M. C. Hinderlider, by the resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming to the Union Pacific, Chicago, Burlington and Quincy, Colorado and Southern, Colorado and Wyoming, and Fremont, Elkhorn and Missouri Valley railroads.

PLATTE RIVER DRAINAGE BASIN.

Platte River, one of the largest tributaries of the Missouri, is formed by the junction of North Platte and South Platte rivers in Lincoln County, Nebr., and flows east into Missouri River 18 miles south of Omaha, Nebr. The principal tributaries of the Platte in Nebraska are Elkhorn and Loup rivers. Elkhorn River rises in the northern part of Nebraska and flows southeast into the Platte about 35 miles above its mouth. North Loup, Middle Loup, and South Loup rivers, with their tributaries, drain north-central Nebraska and join Platte River near Columbus, Nebr.

North Platte River rises in northern Colorado, flows north into Wyoming, and then east into Nebraska. Sweetwater and Laramie rivers are its principal tributaries. The Sweetwater joins it from the west in south-central Wyoming. Laramie River rises in the northern part of Colorado and flows north into the North Platte in eastern Wyoming. The Little Laramie is a small tributary of Laramie River in southern Wyoming.

South Platte River rises in central Colorado, flows north, then east to its junction with North Platte River. Its tributaries are mostly small creeks. Big Thompson Creek joins it 8 miles south of Greeley, Colo. St. Vrain Creek joins it about 15 miles south of Greeley. Cache la Poudre River joins it 6 miles east of Greeley. Clear Creek joins it about 3 miles north of Denver and Bear Creek 8 miles south of Denver.

The following pages contain the results of data collected in the Platte River drainage basin during 1904:

NORTH PLATTE RIVER NEAR HEBRON, COLO.

This station was established May 13, 1904, by M. C. Hinderlider. It is located at the highway bridge below the junction of Big Grizzly and Little Grizzly creeks, about 4 miles northwest of Hebron, Colo. A plain vertical staff gage, graduated to feet and tenths, is fastened to the northeast corner of the first pier from the left bank. It is read once each day by J. E. Mallon. Discharge measurements are made

from the downstream side of the three-span bridge to which the gage is attached, sounding points being marked on the hub rail every 4 feet from zero to 108 feet. The initial point for soundings is the inner face of the left abutment, marked zero on the hub rail downstream side of bridge. The bridge lies in a curve in the river of about 150 feet radius. The current is uniform and of moderate swiftness. Both banks are about 5 feet high, lined with willows, and are not liable to overflow. Below the bridge the left bank becomes a high sandstone cliff. The bed of the stream is composed of gravel, sand, and small cobblestones. It is uniform, free from vegetation, and is permanent. There is but one channel at all stages, broken by two log crib piers. The bridge is at almost right angles to the current. Bench mark No. 1 is a nail driven flush with the top of the cap timber on the west side of the crib pier to which the gage is fastened just across the pier from the gage. Its elevation is 9.445 feet above the zero of the gage. Bench mark No. 2 is a cross cut on a ledge of rock in the cliff on the left bank of the river about 50 feet north of the west end of the bridge and marked "B. M." Its elevation is 17.805 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of North Platte River near Hebron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 13	W. A. Lamb	100	289	1.40	5.15	405
May 26	do	85	425	2.78	6.85	1,180
June 4	do	88	402	2.35	6.45	946
June 27	do	81	305	1.56	5.48	477
July 12	do	64	75	2.12	4.37	159
August 8	do	52	28	2.36	3.80	66
September 12	do	38	32	1.00	3.56	32

Mean daily gage height, in feet, of North Platte River near Hebron, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.30	5.20	4.00	4.00	3.75
2	.....	6.10	5.20	3.95	3.95	3.70
3	.....	6.45	5.10	3.90	3.95	3.70
4	.....	6.30	4.90	3.90	3.90	3.70
5	.....	5.70	4.70	3.85	3.80	3.70
6	.....	5.40	4.60	3.80	3.75	3.65
7	.....	5.30	4.55	3.80	3.75	3.65
8	.....	5.80	4.50	3.80	3.65	3.80
9	.....	6.20	4.50	3.75	3.65	3.80
10	.....	6.30	4.40	3.75	3.60	3.80
11	.....	6.50	4.50	3.75	3.60	3.80
12	.....	6.65	4.35	4.00	3.55	3.80
13	5.15	6.80	4.25	4.50	3.55	3.75
14	5.25	6.75	4.20	4.00	3.50	3.75
15	5.30	6.60	4.10	4.05	3.50	3.75
16	5.40	6.55	4.10	3.95	3.45	3.75
17	5.20	6.30	4.05	4.20	3.45	3.75
18	5.35	6.15	4.05	4.30	3.40	3.75
19	5.55	6.20	4.05	4.20	3.40	3.75
20	5.95	6.20	4.05	4.10	3.45	3.80
21	6.25	6.25	4.05	4.10	3.45	3.80
22	6.35	6.15	4.05	4.10	3.40	3.80
23	6.60	5.80	4.00	4.10	3.40	3.80
24	6.90	5.95	4.05	4.00	3.40	3.75
25	7.00	5.60	4.00	4.00	3.40	3.75
26	6.85	5.50	4.00	3.95	3.50	3.70
27	6.70	5.50	4.00	3.90	3.50	3.70
28	6.20	5.30	4.00	3.90	3.50	3.65
29	6.25	5.20	4.20	3.90	3.55	3.70
30	6.50	5.20	4.10	3.85	3.70	3.65
31	6.60	.....	4.00	3.85	.....	3.65

Rating table for North Platte River near Hebron, Colo., from May 13 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	25	3.95	84	5.00	318	6.10	744
3.45	29	4.00	92	5.10	350	6.20	792
3.50	33	4.10	109	5.20	384	6.30	844
3.55	38	4.20	128	5.30	420	6.40	900
3.60	43	4.30	148	5.40	458	6.50	958
3.65	48	4.40	168	5.50	498	6.60	1,018
3.70	53	4.50	188	5.60	538	6.70	1,082
3.75	58	4.60	210	5.70	578	6.80	1,146
3.80	64	4.70	234	5.80	618	6.90	1,212
3.85	70	4.80	260	5.90	658	7.00	1,280
3.90	77	4.90	288	6.00	700		

The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1904, and is well defined.

Estimated monthly discharge of North Platte River near Hebron, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 13–31	1,280	367	774	29,170
June	1,146	384	738	43,910
July	384	92	158	9,715
August	188	58	90.4	5,558
September	92	25	43.2	2,571
October	64	48	57.0	3,505
The period				94,430

NORTH PLATTE RIVER (NORTH FORK) AT HIGHO, COLO.

This station was established May 14, 1904, by M. C. Hinderlider. It is located at the footbridge at Higho post-office, 7 miles northwest of Hebron and 12 miles west of Walden, Colo. A plain, vertical staff gage is spiked to the southwest face of the left abutment on the downstream side. It is read twice each day by Mrs. Esther Bergquist. Discharge measurements are made at low stages by wading near the gage, and at high water from the single-span footbridge to which the gage is attached. The initial point for soundings is a nail driven into the walk log at the left end of the bridge. The channel is straight for about 150 feet above and 50 feet below the station, and the current is medium. The right bank is about 3 feet high above and for a short distance below the gage, after which it rises to a height of about 10 feet. The left bank is lower than the right, and consists of a low level bar gradually sloping out from the stream and covered with willows. Neither bank overflows except at very high stages. The bed of the stream is composed of gravel and small cobblestones, free from vegetation and permanent. There is but one channel at all stages. Bench mark No. 1 is a nail driven into the top of the east end of the bottom log of the north abutment. It elevation is 1.765 feet above the zero of the gage. Bench mark No. 2 is a point on the foundation stone under the northeast corner of the house of Charles Bergquist, marked "B. M. U. S. G. S." Its elevation is 12.425 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of North Platte River (North Fork) at Higho, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 14[a]	W. A. Lamb	29	24	1.70	1.37	41
May 27	do	29	66	3.47	2.22	229
June 4	do	29	51	2.65	1.92	135
June 16	do	29	60	3.58	2.10	215
June 28	do	29	51	2.94	1.94	150
July 13	do	35	51	2.02	1.80	103
August 9	do	25	37	2.11	1.70	78
September 13[a]	do	31	32	1.25	1.40	40

[a] Wading at different section.

Mean daily gage height, in feet, of North Platte River (North Fork) at Higho, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.95	1.75	1.82	1.65	1.60
2	.....	1.92	1.80	1.75	1.62	1.50
3	.....	2.10	1.85	1.72	1.55	1.45
4	.....	1.88	1.88	1.72	1.52	1.40
5	.....	1.84	1.85	1.68	1.50	1.40
6	.....	1.55	1.80	1.68	1.48	1.40
7	.....	1.62	1.90	1.68	1.45	1.45
8	.....	1.95	1.92	1.68	1.45	1.40
9	.....	2.10	1.88	1.68	1.45	1.45
10	.....	1.95	1.88	1.62	1.45	1.48
11	.....	2.00	1.78	1.62	1.45	1.50
12	.....	2.08	1.82	1.65	1.40	1.48
13	.....	2.12	1.82	1.70	1.40	1.45
14	1.35	2.18	1.75	1.68	1.40	1.50
15	1.40	2.05	1.72	1.68	1.35	1.50
16	1.42	2.05	1.78	1.70	1.35	1.46
17	1.45	2.10	1.65	1.78	1.30	1.45
18	1.48	2.02	1.68	1.85	1.30	1.45
19	1.60	2.15	1.72	1.80	1.32	1.45
20	1.75	2.10	1.78	1.70	1.37	1.50
21	1.85	2.10	1.82	1.72	1.36	1.47
22	1.85	2.10	1.78	1.68	1.38	1.40
23	1.95	2.05	1.80	1.60	1.50	1.38
24	2.10	2.08	1.80	1.60	1.40	1.40
25	2.10	2.05	1.88	1.60	1.40	1.40
26	2.15	2.02	1.88	1.60	1.40	1.35
27	2.25	2.02	1.80	1.60	1.40	1.25
28	2.08	1.90	1.80	1.60	1.40	1.18
29	1.88	1.85	1.82	1.60	1.45	1.15
30	1.98	1.75	1.88	1.60	1.80	1.18
31	2.00	.....	1.85	1.58	.....	1.20

Rating table for North Platte River (North Fork) at Higho, Colo., from May 14 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.15	27	1.45	46	1.75	90	2.00	160
1.20	29	1.50	50	1.80	100	2.10	195
1.25	31	1.55	57	1.85	115	2.20	235
1.30	34	1.60	64	1.90	130	2.30	280
1.35	38	1.65	72	1.95	145	2.40	330
1.40	42	1.70	80				

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 1.35 feet and 2.2 feet.

Estimated monthly discharge of North Platte River (North Fork) at Higho, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 14–31	257	38	124	4,427
June	227	57	159	9,461
July	136	72	105	6,456
August	115	61	77.5	4,765
September	100	34	46.9	2,791
October	64	27	43.3	2,662
The period				30,560

NORTH PLATTE RIVER NEAR COWDREY, COLO.

This station was established May 10, 1904, by M. C. Hinderlider. It is located at the wagon bridge about 2 miles northwest of Cowdrey, Colo. A plain, vertical, staff gage, graduated to feet and tenths, is spiked to the northeast corner of the first crib pier from the west end of the bridge. The foot marks are numbered from 2 to 12 feet, the 2-foot mark resting on the bed of the stream. The gage is read twice each day by A. H. Hendrickson. Discharge measurements are made by means of a five-eighths inch steel cable, car, and tagged wire, located one-fourth mile below the bridge to which the gage is attached. Sounding points are marked every 5 feet on the tagged wire. The initial point for soundings is the zero of the tagged wire, near the left bank. The channel is straight for about 600 feet above and 900 feet below the station, and the current is medium at all stages. The river

at the station has a fall of 4.22 feet to the mile, but along its entire course the fall is much greater. Both banks are high, clean, and do not overflow. The bed of the stream is composed of coarse gravel and small cobblestones, and is firm, stable, and uniform. Bench mark No. 1 is the top of a 30-penny nail driven flush with the top of the cap timber on the north end of the right abutment of the bridge. Its elevation is 13.219 feet above gage datum. Bench mark No. 2 is an iron wagon skein set in the right bank at the right end of the bridge. The top of the hub is 2 inches above the surface of the ground, the base resting on a stone 1 foot below the surface. A witness stake is set beside the bench-mark post. The elevation of bench mark No. 2 is 10.890 feet above gage datum. Bench mark No. 3 is on the hillside, on the right side of river, 55 feet southeast of east end of foot bridge. It is an iron rod 30 x 1¼ inches and has a V-shaped bend on the lower end which rests on a solid boulder 2½ feet underground. The elevation is 400.00 feet above the gage zero.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of North Platte River near Cowdrey, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
May 9	W. A. Lamb	150	324	1.09	7.95	354
May 17[a]	do	110	282	1.71	8.08	482
May 23	do	117	395	2.92	8.90	1,155
May 30	do	116	398	2.77	8.95	1,101
June 7	do	110	310	1.85	8.24	574
June 17	do	110	416	3.23	9.05	1,345
June 29	do	108	312	1.78	8.20	556
July 7	do	107	285	1.70	8.10	484
August 3	do	97	204	0.86	7.60	176
August 22	do	100	208	0.82	7.66	171
September 6	do	92	176	0.53	7.48	94
September 24	do	90	164	0.49	7.42	80

[a] Cable station established.

Mean daily gage height, in feet, of North Platte River near Cowdrey, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	8.90	8.22	7.70	7.55	7.48
2	.....	8.72	8.25	7.65	7.58	7.50
3	.....	8.90	8.22	7.62	7.55	7.50
4	.....	8.95	8.10	7.62	7.55	7.40
5	.....	8.60	8.08	7.58	7.50	7.40
6	.....	8.35	8.02	7.60	7.50	7.55
7	.....	8.20	8.30	7.58	7.55	7.70
8	.....	8.40	8.00	7.55	7.52	7.55
9	.....	8.75	8.00	7.52	7.45	7.70
10	.....	8.80	7.90	7.50	7.45	7.60
11	.....	8.78	7.90	7.55	7.42	7.50
12	7.90	8.95	7.88	7.62	7.30	7.40
13	8.00	9.05	7.80	7.65	7.35	7.40
14	8.00	9.10	7.72	7.55	7.40	7.40
15	8.05	9.05	7.70	7.55	7.38	7.40
16	8.10	9.00	7.70	7.55	7.35	7.40
17	8.10	8.90	7.65	7.62	7.40	7.40
18	8.02	8.90	7.60	7.70	7.40	7.40
19	8.18	8.92	7.68	7.75	7.35	7.40
20	8.38	8.82	7.68	7.70	7.35	7.40
21	8.60	8.82	7.70	7.65	7.35	7.40
22	8.70	8.75	7.68	7.65	7.35	7.40
23	8.75	8.80	7.70	7.65	7.40	7.40
24	9.05	8.72	7.65	7.62	7.40	7.40
25	9.22	8.65	7.75	7.52	7.40	7.40
26	9.30	8.50	7.72	7.55	7.40	7.40
27	9.25	8.40	7.70	7.55	7.40	7.40
28	8.95	8.30	7.70	7.50	7.40	7.40
29	8.80	8.22	7.75	7.55	7.40	7.40
30	8.85	8.22	7.75	7.55	7.40	7.40
31	8.95	.....	7.70	7.55	.....	7.30

Rating table for North Platte River near Cowdrey, Colo., from May 12 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.30	40	7.70	208	8.20	540	8.90	1,172
7.35	55	7.75	238	8.30	622	9.00	1,282
7.40	70	7.80	270	8.40	707	9.10	1,400
7.45	88	7.85	302	8.50	793	9.20	1,523
7.50	108	7.90	334	8.60	880	9.30	1,650
7.55	130	7.95	366	8.70	794	9.40	1,781
7.60	154	8.00	398	8.80	1,070	9.50	1,916
7.65	180	8.10	466				

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904. It is well defined to gage height 9 feet. The table has been extended above gage height 9 feet.

Estimated monthly discharge of North Platte River near Cowdrey, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 12–31	1,650	334	888	35,230
June	1,400	540	1,002	59,629
July	622	154	304	18,690
August	238	108	154	9,469
September	144	40	81.8	4,867
October	208	40	89.2	5,485
The period				133,400

NORTH PLATTE RIVER NEAR PINKHAMPTON, COLO.

This station was established May 11, 1904, by M. C. Hinderlider. It is located at the footbridge on Hunter's ranch, 3 miles northwest of Pinkhampton, Colo. A plain, vertical staff gage, graduated to feet and tenths, is fastened to cantilever arms which extend out over the water on the left bank of the stream, just above the footbridge. The 3-foot mark of the gage rests on the bed of the stream. The gage is read twice each day by Mrs. Glennie Hunter. Discharge measurements are made from the suspension footbridge near which the gage is placed. The bridge is marked every 5 feet up to 160 feet. The initial point for soundings is the top of the left bank beneath the bridge, marked zero with a tin tag fastened to the bridge. The channel is straight for about 600 feet above and one-fourth mile below the station, and the current is medium and uniform. The right bank is low, lined with bushes, and is not liable to overflow. The left bank is about 5 feet high, lined with willows, and seldom overflows. The bed of the stream is composed of cobblestones, some silt, and a few small bowlders. It is uniform, free from vegetation, and permanent. Bench mark No. 1 is a 30-penny nail driven into the west root of a 24-inch cottonwood tree standing on the brow of the hill, about 75 feet east of the east end of the bridge. Its elevation is 16.492 feet above the gage datum. Bench mark No. 2 is a nail driven into the top of post on the left bank, to which the gage is fastened. Its elevation is 11.262 feet above gage datum. Bench mark No. 3 is the top of a wrought-iron rod, 30 inches long and 1¼ inches in diameter, the lower end of which rests upon a large bowlder 2.5 feet underground, 55 feet southeast of the right end of the bridge. Its elevation is 14.00 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of North Platte River near Pinkhampton, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 11	W. A. Lamb	125	326	1.29	4.92	420
May 23	do	138	480	2.66	5.98	1,275
May 31	do	138	535	3.04	6.25	1,624
June 6	do	137	479	2.47	5.91	1,184
August 4	do	108	277	.88	4.55	244
September 5	do	101	247	.75	4.40	187
September 25	do	99	214	.56	4.19	121

Mean daily gage height, in feet, of North Platte River near Pinkhampton, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.30	5.50	4.70	4.45	4.30	4.18
2	.....	6.10	5.70	4.62	4.55	4.30	4.10
3	.....	6.30	.....	4.55	4.60	4.20	4.10
4	.....	6.70	.....	4.50	.....	4.20	4.10
5	.....	6.40	5.45	4.50	.....	4.20	4.10
6	.....	5.96	5.40	4.50	.....	4.10	4.10
7	.....	5.75	5.50	4.50	.....	4.10	4.10
8	.....	5.70	5.40	4.40	.....	4.10	4.10
9	.....	6.20	5.35	4.40	.....	4.10	4.10
10	.....	6.20	5.20	4.40	.....	4.15	.....
11	4.90	6.25	5.10	4.40	4.25	4.20	.....
12	4.95	6.45	5.06	4.70	4.25	4.20	.....
13	5.00	6.50	5.00	4.45	4.20	4.20	.....
14	5.05	6.50	4.92	4.40	4.20	4.20	.....
15	5.10	6.60	4.85	4.40	4.15	4.20	.....
16	5.15	6.50	4.80	4.50	4.10	4.20	.....
17	5.20	6.45	4.75	4.65	4.10	4.20	.....
18	5.15	6.40	4.70	4.80	4.10	4.20	.....
19	5.25	.....	4.70	4.80	4.10	4.30	.....
20	5.35	6.25	4.70	4.70	4.10	4.30	.....
21	5.60	6.20	4.75	4.60	4.10	4.30	.....
22	5.80	6.15	4.70	4.65	4.10	4.30	.....
23	5.95	6.22	4.70	4.58	4.10	4.30	.....
24	6.10	6.10	4.80	4.45	4.20	4.30	.....
25	6.50	6.10	4.75	4.40	4.15	4.30	.....
26	6.75	5.95	4.70	4.42	4.10	4.30	.....
27	6.80	5.75	4.70	4.42	4.20	4.30	.....
28	6.60	5.65	4.70	4.40	4.20	4.25	.....
29	6.50	5.55	4.72	4.40	4.20	4.20	.....
30	6.10	5.45	4.80	4.40	4.25	4.25	.....
31	6.15	.....	4.80	4.45	.....	4.20	.....

Rating table for North Platte River near Pinkhamptor Colo., from May 11 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.10	100	4.50	224	5.30	666	6.10	1,416
4.15	112	4.60	265	5.40	741	6.20	1,543
4.20	125	4.70	310	5.50	821	6.30	1,684
4.25	139	4.80	359	5.60	906	6.40	1,837
4.30	154	4.90	412	5.70	995	6.50	2,000
4.35	170	5.00	469	5.80	1,090	6.60	2,170
4.40	187	5.10	530	5.90	1,192	6.70	2,350
4.45	205	5.20	595	6.00	1,300	6.80	2,540

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined to gage height 6.25 feet. The table has been extended above gage height 6.25 feet.

Estimated monthly discharge of North Platte River near Pinkhampton, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 11–31	2,540	412	1,148	47,820
June	2,350	780	1,547	92,050
July	995	310	499	30,680
August	359	187	231	14,200
September	265	100	144	8,569
October	154	100	133	8,178
November 1–9	120	100	102	1,821
The period	.....	.....	.....	203,300

NORTH PLATTE RIVER AT SARATOGA, WYO.

This station was established June 9, 1903, by A. J. Parshall. The gage consists of a flexible Gurley rod fastened securely to a 3 by 6 inch timber, spiked and braced to the crib work at the northeast corner of Harry Kuykendal's residence, 100 yards below the bridge, on the left bank of the river. The gage is read twice each day by J. M. Sterrett. Discharge measurements are made from the county bridge, a two-span steel structure connecting East and West Saratoga. The initial point for soundings is on the east end of the bridge, at the pier. The channel is straight for 500 feet above and 400 feet below the station. The current has a measurable velocity at all stages. The

left bank is high, but overflows at a gage height of 7 feet. The right bank overflows only at extreme high water. The river has a permanent bed of cobblestone and gravel. There is but one channel, broken by the center pier of the bridge. Bench mark No. 1 is a cross on the south side of the southwest pier at the bottom of the top section. Its elevation is 10.70 feet above the zero of the gage. Bench mark No. 2 is a spike driven in a cottonwood tree standing about 30 feet northwest of the gage. Its elevation is 9.84 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of North Platte River at Saratoga, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 15	A. J. Parshall	215	574	1.06	2.05	607
April 9	do	215	521	1.12	2.05	587
April 12	J. M. Sterrett	225	670	2.02	2.65	1,351
April 15	do	234	773	2.76	3.10	2,132
May 11	do	240	891	3.22	3.60	2,872
May 18	do	246	986	4.17	4.10	4,116
May 20	do	249	1,113	5.14	4.55	5,718
May 23	do	250	1,237	5.86	5.10	7,251
May 26	do	250	1,364	6.27	5.60	8,551
August 10	A. J. Parshall	208	474	.76	1.80	359
August 25	do	210	475	.87	1.90	412
September 20[a]	do	130	129	1.84	1.53	238

[a] Wading one-fourth mile below station.

Mean daily gage height, in feet, of North Platte River at Saratoga, Wyo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.72	.....	2.01	1.98	3.25	4.82	3.45	2.18	2.10	1.98	1.72	1.6
2	1.74	.....	1.98	1.95	3.30	4.80	3.48	2.08	2.08	1.88	1.62	1.62
3	1.78	.....	1.94	2.12	3.32	4.75	3.48	2.02	2.05	1.80	1.65	1.45
4	1.82	.....	1.98	2.12	3.35	4.75	3.42	1.95	2.02	1.78	1.68	1.32
5	1.78	.....	1.92	2.25	3.28	4.52	3.32	1.95	1.95	1.72	1.60	1.35
6	1.74	.....	1.98	2.35	3.28	4.30	3.20	1.90	1.88	1.70	1.65	1.42
7	1.70	.....	2.00	2.28	3.42	4.18	3.30	1.88	1.82	1.70	1.60	1.38
8	1.65	.....	2.28	2.18	3.32	4.40	3.10	1.82	1.78	1.70	1.55	1.50
9	1.60	.....	2.32	2.10	3.38	4.72	3.08	1.80	1.72	1.72	1.58	1.62
10	1.83	.....	2.10	2.12	3.40	4.65	2.98	1.80	1.70	1.82	1.45	1.50
11	1.67	.....	2.30	2.32	3.50	4.78	2.88	1.82	1.70	1.82	1.40	.....
12	1.74	.....	2.35	2.60	3.62	4.88	2.78	1.95	1.65	1.85	1.40	.....
13	1.80	.....	2.12	2.82	3.58	4.98	2.70	2.00	1.65	1.88	1.52	.....
14	1.76	.....	2.15	2.98	3.68	5.00	2.65	2.02	1.60	1.92	1.65	.....
15	1.74	.....	2.08	3.15	3.75	4.92	2.55	2.00	1.60	1.90	1.62	.....
16	1.71	.....	2.00	3.18	3.90	4.88	2.45	2.00	1.60	1.88	1.68	.....
17	1.65	.....	2.02	3.10	3.88	4.80	2.42	2.00	1.58	1.88	1.70	.....
18	1.67	.....	2.15	3.15	4.02	4.65	2.38	2.32	1.55	1.90	1.70	.....
19	1.70	.....	2.20	3.25	4.18	4.58	2.32	2.28	1.52	1.88	1.72	.....
20	1.65	.....	2.30	3.32	4.50	4.52	2.28	2.18	1.52	1.85	1.50	.....
21	1.73	.....	2.12	3.45	4.72	4.42	2.30	2.08	1.60	1.88	1.65	.....
22	1.76	.....	2.22	3.32	4.78	4.40	2.30	2.02	1.60	1.85	1.58	.....
23	1.80	.....	2.22	3.15	5.00	4.32	2.22	2.00	1.60	1.88	1.60	.....
24	1.76	.....	2.20	3.00	5.18	4.28	2.22	2.00	1.68	1.85	1.50	.....
25	1.80	.....	2.08	2.90	5.42	4.10	2.35	1.98	1.70	1.82	1.60	.....
26	1.83	.....	2.00	2.88	5.48	3.95	2.32	1.90	1.70	1.78	1.45	.....
27	1.84	.....	2.00	2.98	5.20	3.82	2.22	1.92	1.70	1.78	1.58	.....
28	1.82	.....	2.00	3.15	5.05	3.68	2.12	1.95	1.65	1.75	1.65	.....
29	1.85	(a)	1.98	3.35	4.90	3.60	2.18	1.95	1.70	1.75	1.50	.....
30	1.88	.....	2.00	3.28	4.88	3.50	2.20	1.95	1.82	1.78	1.58	.....
31	1.90	.....	1.95	.....	4.95	.....	2.20	2.00	.....	1.75	.....	.....

a River free from ice.

Rating table for North Platte River at Saratoga, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	165	2.30	780	3.40	2,500	4.50	5,445
1.35	180	2.40	890	3.50	2,710	4.60	5,760
1.40	195	2.50	1,010	3.60	2,935	4.70	6,080
1.45	210	2.60	1,140	3.70	3,170	4.80	6,400
1.50	225	2.70	1,280	3.80	3,415	4.90	6,720
1.60	260	2.80	1,430	3.90	3,670	5.00	7,040
1.70	305	2.90	1,590	4.00	3,935	5.10	7,360
1.80	360	3.00	1,760	4.10	4,220	5.20	7,680
1.90	425	3.10	1,940	4.20	4,520	5.30	8,010
2.00	500	3.20	2,120	4.30	4,825	5.40	8,340
2.10	585	3.30	2,305	4.40	5,135	5.50	8,670
2.20	680						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904, and is fairly well defined.

Estimated monthly discharge of North Platte River at Saratoga, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January[a]	425	260	336	20,660
March	835	439	588	36,160
April	2,600	460	1,480	88,070
May	8,604	2,210	4,487	295,900
June	7,040	2,710	5,385	320,400
July	2,666	603	1,340	82,390
August	802	360	499	30,680
September	585	231	332	19,760
October	484	305	375	23,060
November	315	195	259	15,410
December 1–10	268	171	216	4,284
The period				936,800

[a] Ice conditions uncertain during January.

Mean daily gage height, in feet, of North Platte River at Saratoga, Wyo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.72	.....	2.01	1.98	3.25	4.82	3.45	2.18	2.10	1.98	1.72	1.48
2	1.74	.....	1.98	1.95	3.30	4.80	3.48	2.08	2.08	1.88	1.62	1.62
3	1.78	.....	1.94	2.12	3.32	4.75	3.48	2.02	2.05	1.80	1.65	1.45
4	1.82	.....	1.98	2.12	3.35	4.75	3.42	1.95	2.02	1.78	1.68	1.32
5	1.78	.....	1.92	2.25	3.28	4.52	3.32	1.95	1.95	1.72	1.60	1.35
6	1.74	.....	1.98	2.35	3.28	4.30	3.20	1.90	1.88	1.70	1.65	1.42
7	1.70	.....	2.00	2.28	3.42	4.18	3.30	1.88	1.82	1.70	1.60	1.38
8	1.65	.....	2.28	2.18	3.32	4.40	3.10	1.82	1.78	1.70	1.55	1.50
9	1.60	.....	2.32	2.10	3.38	4.72	3.08	1.80	1.72	1.72	1.58	1.62
10	1.83	.....	2.10	2.12	3.40	4.65	2.98	1.80	1.70	1.82	1.45	1.50
11	1.67	.....	2.30	2.32	3.50	4.78	2.88	1.82	1.70	1.82	1.40	.....
12	1.74	.....	2.35	2.60	3.62	4.88	2.78	1.95	1.65	1.85	1.40	.....
13	1.80	.....	2.12	2.82	3.58	4.98	2.70	2.00	1.65	1.88	1.52	.....
14	1.76	.....	2.15	2.98	3.68	5.00	2.65	2.02	1.60	1.92	1.65	.....
15	1.74	.....	2.08	3.15	3.75	4.92	2.55	2.00	1.60	1.90	1.62	.....
16	1.71	.....	2.00	3.18	3.90	4.88	2.45	2.00	1.60	1.88	1.68	.....
17	1.65	.....	2.02	3.10	3.88	4.80	2.42	2.00	1.58	1.88	1.70	.....
18	1.67	.....	2.15	3.15	4.02	4.65	2.38	2.32	1.55	1.90	1.70	.....
19	1.70	.....	2.20	3.25	4.18	4.58	2.32	2.28	1.52	1.88	1.72	.....
20	1.65	.....	2.30	3.32	4.50	4.52	2.28	2.18	1.52	1.85	1.50	.....
21	1.73	.....	2.12	3.45	4.72	4.42	2.30	2.08	1.60	1.88	1.65	.....
22	1.76	.....	2.22	3.32	4.78	4.40	2.30	2.02	1.60	1.85	1.58	.....
23	1.80	.....	2.22	3.15	5.00	4.32	2.22	2.00	1.60	1.88	1.60	.....
24	1.76	.....	2.20	3.00	5.18	4.28	2.22	2.00	1.68	1.85	1.50	.....
25	1.80	.....	2.08	2.90	5.42	4.10	2.35	1.98	1.70	1.82	1.60	.....
26	1.83	.....	2.00	2.88	5.48	3.95	2.32	1.90	1.70	1.78	1.45	.....
27	1.84	.....	2.00	2.98	5.20	3.82	2.22	1.92	1.70	1.78	1.58	.....
28	1.82	.....	2.00	3.15	5.05	3.68	2.12	1.95	1.65	1.75	1.65	.....
29	1.85	(a)	1.98	3.35	4.90	3.60	2.18	1.95	1.70	1.75	1.50	.....
30	1.88	.....	2.00	3.28	4.88	3.50	2.20	1.95	1.82	1.78	1.58	.....
31	1.90	.....	1.95	.....	4.95	.....	2.20	2.00	.....	1.75	.....	.....

a River free from ice.

Rating table for North Platte River at Saratoga, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	165	2.30	780	3.40	2,500	4.50	5,445
1.35	180	2.40	890	3.50	2,710	4.60	5,760
1.40	195	2.50	1,010	3.60	2,935	4.70	6,080
1.45	210	2.60	1,140	3.70	3,170	4.80	6,400
1.50	225	2.70	1,280	3.80	3,415	4.90	6,720
1.60	260	2.80	1,430	3.90	3,670	5.00	7,040
1.70	305	2.90	1,590	4.00	3,935	5.10	7,360
1.80	360	3.00	1,760	4.10	4,220	5.20	7,680
1.90	425	3.10	1,940	4.20	4,520	5.30	8,010
2.00	500	3.20	2,120	4.30	4,825	5.40	8,340
2.10	585	3.30	2,305	4.40	5,135	5.50	8,670
2.20	680						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904, and is fairly well defined.

Estimated monthly discharge of North Platte River at Saratoga, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January[a]	425	260	336	20,660
March	835	439	588	36,160
April	2,600	460	1,480	88,070
May	8,604	2,210	4,487	295,900
June	7,040	2,710	5,385	320,400
July	2,666	603	1,340	82,390
August	802	360	499	30,680
September	585	231	332	19,760
October	484	305	375	23,060
November	315	195	259	15,410
December 1–10	208	171	216	4,284
Th				936,800

[a] ...ary.

NORTH PLATTE RIVER AT ALCOVA, WYO.

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Discharge measurements of North Platte River at Alcova, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 1	J. E. Field	270	1,116	2.96	7.20	3,308
June 5	do	278	1,487	5.25	9.50	7,802
June 10	E. C. Woodward	279	1,401	4.78	9.00	6,696
June 20	do	283	1,471	5.51	9.45	8,112
June 20	J. E. Field	280	1,435	5.26	9.10	7,546
July 17	do	210	642	2.02	5.55	1,300

Mean daily gage height, in feet, of North Platte River at Alcova, Wyo., for 1904.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.98	4.95	7.20	9.60	7.30	4.80	4.50	4.18	4.40
2	.....	5.30	4.98	7.12	9.55	7.30	4.80	4.50	4.20	4.40
3	.....	5.18	4.88	7.15	9.50	7.30	4.80	4.55	4.25	4.40
4	.....	4.95	4.88	7.25	9.45	7.20	4.75	4.70	4.45	4.38
5	.....	4.95	4.90	7.25	9.45	7.32	4.70	4.62	4.40	4.32
6	.....	4.90	4.92	7.30	9.20	7.30	4.65	5.58	4.35	4.28
7	.....	5.02	5.10	7.38	8.80	6.95	4.58	4.50	4.20	4.25
8	.....	5.00	5.30	7.39	8.55	6.85	4.50	4.48	4.30	4.25
9	.....	4.90	5.15	7.52	8.55	6.78	4.50	4.38	4.20	4.20
10	.....	5.00	5.30	7.55	9.20	6.65	4.42	4.30	4.20	4.20
11	.....	5.38	5.20	7.38	9.25	6.40	4.40	4.22	4.20	4.05
12	.....	5.52	5.05	7.40	9.50	6.25	4.40	4.20	4.20	3.85
13	.....	5.22	5.08	7.65	9.50	6.10	4.40	4.18	4.45	3.65
14	.....	5.32	5.65	7.75	9.65	5.95	4.35	4.10	4.50	3.45
15	.....	5.45	6.05	7.90	9.70	5.80	4.38	4.10	4.50	3.40
16	.....	5.28	6.35	7.80	9.65	5.72	4.58	4.02	4.50	3.45
17	.....	5.18	6.48	8.05	9.55	5.60	4.62	4.00	4.50	3.55
18	.....	5.15	6.45	8.15	9.40	5.45	4.70	4.00	4.50	3.75
19	.....	5.05	6.40	8.52	9.20	5.35	4.70	3.92	4.50	3.90
20	.....	5.02	6.52	9.18	9.10	5.30	4.78	3.85	4.50	.....
21	4.20	5.05	6.68	9.15	9.05	5.18	4.98	3.80	4.50	.....
22	4.25	5.15	6.92	9.50	8.85	5.05	4.88	3.88	4.50	.....
23	4.25	5.15	6.95	9.60	8.75	5.00	4.75	3.88	4.50	.....
24	4.40	5.20	6.90	9.88	8.60	5.00	4.62	3.90	4.72	.....
25	4.55	5.02	6.75	10.35	8.45	4.95	4.58	3.90	4.72	.....
26	4.65	4.88	6.55	10.60	8.30	5.00	4.50	3.92	4.50	.....
27	4.95	4.65	6.35	10.85	8.05	4.90	4.50	3.90	4.50	.....
28	5.30	4.70	6.35	10.50	7.80	4.90	4.58	3.95	4.50	.....
29	5.10	5.08	6.48	10.20	7.45	5.00	4.65	4.05	4.50	.....
30	.....	5.12	6.92	9.80	7.30	4.90	4.45	4.08	4.68	.....
31	.....	4.95	.....	9.45	.....	4.80	4.45	.....	4.40	.....

NORTH PLATTE RIVER NEAR GUERNSEY, WYO.

This station was established June 14, 1900, by A. J. Parshall. It is located at the county bridge about a half mile northwest of Guernsey. The bridge has eight piers, the sides are planked, and there is uniform flow under each span. The rod originally consisted of a 4 by 4 inch scantling 12 feet long firmly attached to one of the piers of the bridge. As the station was to be a temporary one, a metallic tape, divided into feet and tenths, was securely fastened to the rod.

It was found that considerable inconvenience was caused by sand accumulating about the rod as the high water subsided. With the opening of the season of 1902 a new rod was placed about 200 feet above the first location. It was fastened to one of the piers of the railroad bridge, and was placed 1 foot lower in the water.

The 1902 bench mark is a spike driven into a cross beam of the bridge 1 foot from the rod and at an elevation of 10.04 feet above the zero. The channel is straight for a distance above and below the station.

NORTH PLATTE RIVER AT ALCOVA, WYO.

This station was established February 19, 1904, by John E. Field. It is located at the highway bridge 1,000 feet southwest of the post-office at Alcova, Wyo. There are no running tributaries entering the river in this vicinity. The gage is a 2 by 6 inch plank nailed to the northeast corner of the crib pier supporting the center of the bridge. The gage is read twice a day by A. F. Hollebaugh, the postmaster. Measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the north end of the downstream hand rail. The channel is straight for 1,500 feet above and 800 feet below the station. The current is swift in the center and sluggish near the banks. Both banks are high, clean, and not liable to overflow. The bed of the stream is rocky, covered with small bowlders, and is permanent. The river is divided by the bridge piers into ten channels at low water and thirteen channels at high water. The bottom at the measuring section is rough and uneven, and this may affect the accuracy somewhat. The bench mark is a standard United States Geological Survey iron post located at the west quarter corner of sec. 19, T. 30 N., R. 82 W. It is about 1,000 feet due north of the post-office. Its elevation is 5,366 feet above sea level and 36.67 feet above the gage datum.

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Discharge measurements of North Platte River at Alcova, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 1	J. E. Field	270	1,116	2.96	7.20	3,308
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Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.98	4.95	7.20	9.60	7.30	4.80	4.50	4.18	1.40
2	.....	5.30	4.98	7.12	9.55	7.30	4.80	4.50	4.20	4.40
3	.....	5.18	4.88	7.15	9.50	7.30	4.80	4.55	4.25	4.40
4	.....	4.95	4.88	7.25	9.45	7.20	4.75	4.70	4.45	4.38
5	.....	4.95	4.90	7.25	9.45	7.32	4.70	4.62	4.40	4.32
6	.....	4.90	4.92	7.30	9.20	7.30	4.65	5.58	4.35	4.28
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8	.....	5.00	5.30	7.39	8.55	6.85	4.50	4.48	4.30	4.25
9	.....	4.90	5.45	7.52	8.55	6.78	4.50	4.38	4.20	4.20
10	.....	5.00	5.30	7.55	9.20	6.65	4.42	4.30	4.20	4.20
11	.....	5.38	5.20	7.38	9.25	6.40	4.40	4.22	4.20	4.05
12	.....	5.52	5.05	7.40	9.50	6.25	4.40	4.20	4.20	3.85
13	.....	5.22	5.08	7.65	9.50	6.10	4.40	4.18	4.45	3.65
14	.....	5.32	5.65	7.75	9.65	5.95	4.35	4.10	4.50	3.45
15	.....	5.45	6.05	7.90	9.70	5.80	4.38	4.10	4.50	3.40
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18	.....	5.15	6.45	8.15	9.40	5.45	4.70	4.00	4.50	3.75
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20	.....	5.02	6.52	9.18	9.10	5.30	4.78	3.85	4.50	.....
21	4.20	5.05	6.68	9.15	9.05	5.18	4.98	3.80	4.50	.....
22	4.25	5.15	6.92	9.50	8.85	5.05	4.88	3.88	4.50	.....
23	4.25	5.15	6.95	9.60	8.75	5.00	4.75	3.88	4.50	.....
24	4.40	5.20	6.90	9.88	8.60	5.00	4.62	3.90	4.72	.....
25	4.55	5.02	6.75	10.35	8.45	4.95	4.58	3.90	4.72	.....
26	4.65	4.88	6.55	10.60	8.30	5.00	4.50	3.92	4.50	.....
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4	.....	4.95	4.88	7.25	9.45	7.20	4.75	4.70	4.45	4.38
5	.....	4.95	4.90	7.25	9.45	7.32	4.70	4.62	4.40	4.32
6	.....	4.90	4.92	7.30	9.20	7.30	4.65	5.58	4.35	4.28
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10	.....	5.00	5.30	7.55	9.20	6.65	4.42	4.30	4.20	4.20
11	.....	5.38	5.20	7.38	9.25	6.40	4.40	4.22	4.20	4.05
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18	.....	5.15	6.45	8.15	9.40	5.45	4.70	4.00	4.50	3.75
19	.....	5.05	6.40	8.52	9.20	5.35	4.70	3.92	4.50	3.90
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22	4.25	5.15	6.92	9.50	8.85	5.05	4.88	3.88	4.50	.....
23	4.25	5.15	6.95	9.60	8.75	5.00	4.75	3.88	4.50	.....
24	4.40	5.20	6.90	9.88	8.60	5.00	4.62	3.90	4.72	.....
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28	5.30	4.70	6.35	10.50	7.80	4.90	4.58	3.95	4.50	.....
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4		4.95	4.88	7.25	9.45	7.20	4.75	4.70	4.45	4.38
5		4.96	4.90	7.25	9.45	7.32	4.70	4.62	4.40	4.32
6		4.90	4.92	7.30	9.20	7.30	4.65	5.58	4.35	4.28
7		5.02	5.10	7.38	8.80	6.95	4.58	4.50	4.20	4.25
8		5.00	5.30	7.39	8.55	6.85	4.50	4.48	4.30	4.25
9		4.90	5.45	7.52	8.55	6.78	4.50	4.38	4.20	4.20
10		5.00	5.30	7.55	9.20	6.65	4.42	4.30	4.20	4.20
11		5.38	5.20	7.38	9.25	6.40	4.40	4.22	4.20	4.05
12		5.52	5.05	7.40	9.50	6.25	4.40	4.20	4.20	3.85
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14		5.32	5.65	7.75	9.65	5.95	4.35	4.10	4.50	3.45
15		5.45	6.05	7.90	9.70	5.80	4.38	4.10	4.50	3.40
16		5.28	6.35	7.80	9.65	5.72	4.58	4.02	4.50	3.45
17		5.18	6.48	8.05	9.55	5.60	4.62	4.00	4.50	3.55
18		5.15	6.45	8.15	9.40	5.45	4.70	4.00	4.50	3.75
19		5.05	6.40	8.52	9.20	5.35	4.70	3.92	4.50	3.90
20		5.02	6.52	9.18	9.10	5.30	4.78	3.85	4.50	.....
21	4.20	5.05	6.68	9.15	9.05	5.18	4.98	3.80	4.50	.....
22	4.25	5.15	6.92	9.50	8.85	5.05	4.88	3.88	4.50	.....
23	4.25	5.15	6.95	9.60	8.75	5.00	4.75	3.88	4.50	.....
24	4.40	5.20	6.90	9.88	8.60	5.00	4.62	3.90	4.72	.....
25	4.55	5.02	6.75	10.35	8.45	4.95	4.58	3.90	4.72	.....
26	4.65	4.88	6.55	10.60	8.30	5.00	4.50	3.92	4.50	.....
27	4.95	4.65	6.35	10.85	8.05	4.90	4.50	3.90	4.50	.....
28	5.30	4.70	6.35	10.50	7.80	4.90	4.58	3.95	4.50	.....
29	5.10	5.08	6.48	10.20	7.45	5.00	4.65	4.05	4.50	.....
30		5.12	6.92	9.80	7.30	4.90	4.45	4.08	4.68	.....
31		4.95	.....	9.45	.....	4.80	4.45	.....	4.40	.....

NORTH PLATTE RIVER NEAR GUERNSEY, WYO.

This station was established June 14, 1900, by A. J. Parshall. It is located at the county bridge about a half mile northwest of Guernsey. The bridge has eight piers, the sides are planked, and there is uniform flow under each span. The rod originally consisted of a 4 by 4 inch scantling 12 feet long firmly attached to one of the piers of the bridge. As the station was to be a temporary one, a metallic tape, divided into feet and tenths, was securely fastened to the rod.

It was found that considerable inconvenience was caused by sand accumulating about the rod as the high water subsided. With the opening of the season of 1902 a new rod was placed about 200 feet above the first location. It was fastened to one of the piers of the railroad bridge, and was placed 1 foot lower in the water.

The 1902 bench mark is a spike driven into a cross beam of the bridge 1 foot from the rod and at an elevation of 10.04 feet above the zero. The channel is straight for a distance above and below the station.

Both banks are high and do not overflow at high stages. The bed of the stream is sandy, but probably does not shift much.

During the latter part of the season of 1903 the 1902 gage was replaced by a new rod, with its zero at the same elevation as that of the old gage. The new rod is attached to a pile of the railroad bridge, which has been recently reconstructed. In February, 1904, the elevation of the new rod was checked with the temporary bench mark and by comparison with the readings of the old rods which are still in place. This comparison shows that the rod has settled 0.076 foot. The 1903 bench mark is a monument set 125 feet southeast of the rod at an elevation of 13.65 feet above the zero of the gage and 4,331 feet above sea level.

Measurements are still made from the county bridge, which, though it does not furnish a perfect location for measurements, is the best yet found on the river in Wyoming below the Saratoga station.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of North Platte River near Guernsey, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 18	A. J. Parshall	279	538	2.39	1.10	1,288
April 27	J. E. Field	.....	849	3.24	2.10	2,750
May 12	A. J. Parshall	331	1,107	4.40	2.80	4,871
June 8	.....do	337	1,861	5.65	5.25	10,510
June 15	.....do	238	1,835	5.42	5.00	9,934
July 4	.....do	337	1,101	3.92	2.85	4,311
July 21	.....do	216	498	3.21	1.35	1,600
July 30	.....do	175	410	2.42	.90	1,094
August 5	.....do	172	358	2.45	.70	878
August 29	.....do	170	322	1.99	.50	640
September 5	.....do	166	302	1.86	.45	564
September 15	.....do	165	287	1.73	.37	498
September 28 [a]	.....do	132	249	1.29	.10	322
October 24	.....do	168	312	1.88	.48	586
October 27	.....do	168	308	1.88	.48	578

[a] This measurement was made by wading at a point 100 feet above county bridge.

Mean daily gage height, in feet, of North Platte River near Guernsey, Wyo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.90	.....	0.85	0.80	1.90	5.05	3.15	0.80	0.40	0.18	0.50	0.22
2	.90	.....	1.00	.80	1.95	4.90	3.05	.80	.40	.15	.50	.30
3	.90	.....	.95	.85	2.30	4.80	2.90	.70	.80	.15	.50	.42
4	.90	.....	.90	.90	3.25	4.80	2.90	.70	.70	.15	.50	.50
5	.90	.....	1.00	.85	3.15	5.45	3.00	.70	.55	.15	.50	.50
6	.90	.....	1.65	.80	3.05	5.65	3.10	.70	.50	.20	.50	.30
7	.90	.....	1.15	.80	2.95	5.40	3.00	.70	.48	.22	.50	.30
8	.90	.....	1.05	.80	2.90	5.10	3.00	.70	.42	.28	.40	.30
9	.90	.....	.85	.85	2.90	5.40	2.90	.60	.40	.35	.40	.30
10	.80	.....	.80	.90	3.00	5.40	2.75	.60	.40	.36	.40	.30
11	.80	.....	.90	.95	2.95	5.00	2.60	.55	.40	.30	.40	.55
12	.80	.....	.90	1.00	2.80	5.20	2.45	.50	.40	.30	.40	.70
13	.80	.....	.90	1.00	2.70	5.20	2.25	.50	.40	.30	.38	.70
14	.80	.....	1.10	1.00	2.70	5.15	2.05	.50	.38	.42	.35	.70
15	.90	.....	1.30	1.00	2.75	5.05	1.95	.50	.35	.70	.35	.55
16	.90	.....	1.20	1.00	2.90	5.10	1.90	.50	.30	1.70	.30	.....
17	.90	.....	1.20	1.15	2.90	5.10	1.80	.50	.30	1.15	.28	.....
18	.80	.....	1.10	1.55	2.90	5.00	1.65	.45	.25	.85	.20	.....
19	.90	.....	1.00	1.75	2.95	4.90	1.55	.45	.20	.68	.15	.....
20	.90	.....	1.00	1.95	3.05	4.80	1.45	.60	.20	.60	.15	.....
21	1.00	.....	.95	2.00	3.20	4.70	1.35	.60	.20	.60	.15	.....
22	1.00	.....	.90	1.95	5.55	4.55	1.30	.60	.18	.58	.15	.....
23	1.00	.....	.90	2.00	4.35	4.45	1.45	.60	.15	.60	.20	.....
24	1.00	.....	.90	2.05	4.40	4.35	1.25	.60	.15	.58	.22	.....
25	.90	.....	.95	2.10	4.55	4.30	1.15	.60	.10	.55	.28	.....
26	1.00	.....	1.05	2.10	4.75	4.15	1.10	.60	.10	.50	.30	.....
27	1.00	.....	1.00	2.05	5.05	3.95	1.00	.55	.10	.50	.38	.....
28	1.00	.....	1.00	2.00	5.35	3.80	1.00	.50	.10	.50	.40	.....
29	1.00	.....	.95	2.00	5.45	3.65	.95	.48	.10	.50	.38	.....
30	1.00	.....	.90	1.90	5.25	3.40	.90	.45	.20	.50	.28	.....
31	1.00	.....	.80	.....	5.20	.....	.80	.45	.....	.50	.....	.....

NOTE.—Ice conditions uncertain during January.

Rating table for North Platte River near Guernsey, Wyo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	320	1.40	1,710	2.70	3,960	3.90	7,000
.20	390	1.50	1,850	2.80	4,190	4.00	7,260
.30	460	1.60	2,000	2.90	4,430	4.20	7,780
.40	540	1.70	2,150	3.00	4,680	4.40	8,300
.50	630	1.80	2,300	3.10	4,930	4.60	8,820
.60	730	1.90	2,460	3.20	5,180	4.80	9,340
.70	830	2.00	2,620	3.30	5,440	5.00	9,860
.80	940	2.10	2,790	3.40	5,700	5.20	10,380
.90	1,060	2.20	2,960	3.50	5,960	5.40	10,900
1.00	1,180	2.30	3,140	3.60	6,220	5.60	11,420
1.10	1,310	2.40	3,330	3.70	6,480	5.80	11,940
1.20	1,440	2.50	3,530	3.80	6,740	6.00	12,460
1.30	1,570	2.60	3,740				

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1904. It is well defined between gage heights 0 feet and 3 feet. Above gage height 3 feet the curve is determined by two measurements at 5 feet gage height. Above gage height 3.40 feet the rating curve is a tangent, the difference being 260 per tenth.

Estimated monthly discharge of North Platte River near Guernsey, Wyo., for 1904.

[Drainage area, 16,240 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,180	940	1,075	66,100	0.066	0.076
March	2,075	940	1,191	73,230	.073	.084
April	2,790	940	1,712	101,900	.105	.117
May	11,290	2,460	6,075	373,500	.374	.431
June	11,550	5,700	9,318	554,500	.574	.640
July	5,055	940	2,802	172,300	.173	.199
August	940	585	715	43,960	.044	.051
September	940	320	488	29,040	.030	.033
October	2,150	355	652	40,090	.040	.046
November	630	355	503	29,930	.031	.035
December 1–15	830	404	589	17,520	.036	.020
The period				1,502,000		

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station was established June 3, 1902, by O. V. P. Stout, assisted by R. H. Willis. It is located at the highway bridge 1 mile south of Mitchell, Nebr. It replaces the station at Gering, Nebr., which was discontinued, as the narrower channel at Mitchell seemed favorable to increased accuracy of gagings, and, being nearer the Wyoming line, it serves better as a State-line gaging station. The gage is of the standard chain type. The scale is inclosed in a box fastened to the upstream hand rail near the center of the bridge. The length of the chain from the end of the weight to the marker is 10.60 feet. The gage is read once each day by J. L. McCoy.

On April 4, 1902, a temporary gage rod was set whose zero mark was 3.79 feet lower than the old rod of 1901. On May 3, 1902, a new permanent gage was put in whose zero mark was 1 foot lower than the old rod of 1901, in order to avoid negative gage heights. Hence, between April 4 and May 3, 1902, 2.79 feet was subtracted from the gage heights reported by the observer. To make the gage heights reported during 1901 comparable with those of 1902 and following years, 1 foot must be added.

Discharge measurements are made from the upstream side of the highway bridge, which is supported by pile bents 20 feet apart. The upstream hand rail is marked at intervals of 12½ feet with blue paint and at intervals of 10 feet with white paint. The initial point for soundings is the zero mark at the north end of the bridge. The channel is straight for 2,000 feet above and below the station. The mean velocity varies from 1 foot at low stages to 4 feet per second at high stages. Both banks are low and sandy, but are not liable to overflow. There is a rather large island in the gaging section. At high stages there are three channels, and at low stages there are from three to forty channels. The bridge has a total span of 1,565 feet. At low water the channels are too shallow for current-meter measurements, and at such times velocities must be estimated or determined with floats. Bench mark No. 1 is a cross cut in the floor of the bridge at the gage. Its elevation is 9.74 feet above gage datum. Bench mark No. 2 is the head of a nail driven in the top at the west end of the cap of the first bent at the north end of the bridge. Its elevation is 8.56 feet above gage datum. Bench mark No. 3 is a standard aluminum bench-mark cap of the Geological Survey leaded into the top of a 2-inch gas pipe 4 feet long, with a plate at the bottom. It is located 138 feet north of the north end of the bridge and 30 feet east of the line of the downstream hand rail extended. It is 2 feet outside of a wire fence. Its elevation is 8.64 feet above the gage datum. The gage datum is the water surface when the chain gage reads zero.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec. feet.*
March 29	M. D. McWilliams	679	1.88	2.30	1,273
April 23	J. C. Stevens	931	2.03	2.58	1,890
May 9	M. D. McWilliams	1,893	2.68	3.40	5,070
May 23	do	3,659	3.25	4.74	11,890
June 9	J. C. Stevens	3,207	3.46	4.60	11,100
July 9	do	1,572	2.89	3.15	4,540
September 27	R. D. Hubbard	115	1.90	1.75	219
September 29[a]	A. J. Parshall	122	1.75	1.72	214
September 30[a]	do	145	1.83	1.80	266

[a] Wading at different section.

Mean daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1904.

Day.	Jan.[a]	Feb.[b]	Mar.[b]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[c]
1	2.08	.....	.....	2.22	2.75	4.30	3.30	2.12	1.97	1.75	1.87	1.81
2	2.00	2.50	.....	2.15	2.80	4.50	3.28	2.16	1.93	1.72	1.86	1.83
3	1.95	2.25	.....	2.14	2.84	4.40	3.40	2.13	1.90	1.70	1.85	1.86
4	1.85	2.20	.....	2.32	2.94	4.60	3.07	2.12	1.95	1.73	1.80	1.78
5	2.03	2.22	.....	2.30	3.70	4.35	3.00	2.10	1.93	1.75	1.86	1.71
6	1.97	2.23	2.53	2.27	3.90	4.50	3.15	2.11	1.95	1.70	1.87	1.73
7	1.85	2.20	2.45	2.25	3.84	4.70	3.23	2.15	1.97	1.75	1.88	1.72
8	1.90	2.15	2.60	2.27	3.70	4.80	3.20	2.09	1.93	1.77	1.89	1.71
9	2.12	2.17	2.55	2.18	3.58	4.75	3.15	2.11	1.90	1.70	1.86	1.72
10	1.87	2.25	2.57	2.17	3.49	4.73	3.10	2.11	1.95	1.75	1.88	1.74
11	2.10	2.20	2.55	2.18	3.45	4.60	3.05	2.08	1.85	1.73	1.89	1.75
12	2.00	2.23	2.50	2.15	3.40	4.40	3.00	2.02	1.87	1.76	1.98	1.77
13	2.15	2.19	2.47	2.20	3.37	4.55	2.90	2.00	1.85	1.70	1.97	1.80
14	2.12	.....	2.45	2.25	3.35	4.60	2.85	2.05	1.90	1.75	1.96	1.78
15	2.25	.....	2.43	2.19	3.33	4.35	2.75	2.07	1.92	1.70	1.98	1.76
16	2.15	.....	2.45	2.20	3.37	4.20	2.63	2.00	1.95	1.78	1.97	1.73
17	2.30	.....	2.47	2.18	3.45	4.30	2.60	2.01	1.90	1.75	1.95	2.30
18	2.37	.....	2.46	2.13	3.47	4.40	2.59	2.05	1.89	1.72	1.93	2.30
19	2.35	.....	2.47	2.10	3.48	4.30	2.58	1.95	1.92	2.05	1.94	2.30
20	2.38	.....	2.45	2.30	3.45	4.50	2.55	2.00	1.85	2.00	1.95	2.00
21	2.40	.....	2.47	2.60	3.72	4.40	2.53	2.03	1.87	1.95	1.97	1.90
22	2.45	.....	2.43	2.58	3.67	4.15	2.50	1.95	1.83	1.92	1.89	1.80
23	2.45	.....	2.42	2.60	4.90	4.20	2.48	1.97	1.85	1.90	1.87	1.77
24	.....	.....	2.38	2.65	4.90	[d]4.35	2.48	1.90	1.87	1.95	1.86	1.76
25	.....	.....	2.30	2.71	4.00	[d]4.50	2.45	1.95	1.83	1.93	1.85	.....
26	.....	.....	2.34	2.75	4.30	4.65	2.42	1.93	1.80	1.95	1.87	.....
27	.....	.....	2.32	2.80	4.20	4.57	2.45	1.94	1.82	1.90	1.88	.....
28	.....	.....	2.35	2.79	4.50	4.40	2.40	1.92	1.79	1.88	1.84	.....
29	.....	.....	2.31	2.81	4.10	4.30	2.35	1.93	1.75	1.92	1.85	.....
30	.....	.....	2.30	2.82	4.80	3.90	2.30	1.90	1.77	1.92	1.83	.....
31	.....	.....	2.32	.....	4.50	.....	2.26	1.94	.....	1.87	.....	.....

[a] River frozen January 24 to February 1.
[b] River frozen February 14 to March 5.
[c] River frozen December 25 to 31.
[d] Gage height interpolated.

Rating table for North Platte River near Mitchell, Nebr., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	70	2.60	2,175	3.60	6,205	4.60	11,080
1.70	170	2.70	2,535	3.70	6,655	4.70	11,610
1.80	280	2.80	2,905	3.80	7,115	4.80	12,150
1.90	400	2.90	3,285	3.90	7,580	4.90	12,700
2.00	540	3.00	3,675	4.00	8,055	5.00	13,255
2.10	710	3.10	4,075	4.10	8,540	5.10	13,820
2.20	930	3.20	4,485	4.20	9,030	5.20	14,395
2.30	1,200	3.30	4,905	4.30	9,530	5.30	14,975
2.40	1,505	3.40	5,330	4.40	10,040	5.40	15,565
2.50	1,830	3.50	5,765	4.50	10,555	5.50	16,165

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904 and is fairly well defined.

Estimated monthly discharge of North Platte River near Mitchell, Nebr., for 1904.

[Drainage area, 24,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1–23[a]	1,667	340	867	39,550	0.036	0.031
February 2–13	1,830	820	1,029	24,490	.042	.019
March 6–31	2,175	1,200	1,632	84,160	.067	.065
April	2,981	710	1,511	89,910	.062	.069
May	12,700	2,720	6,873	422,600	.282	.325
June[b]	12,150	7,580	10,270	611,100	.421	.470
July	5,330	1,092	2,875	176,800	.118	.136
August	842	400	594	36,520	.024	.028
September	498	225	382	22,730	.016	.018
October	625	170	307	18,880	.013	.015
November	512	280	398	23,680	.016	.018
December	1,200	181	381	18,140	.016	.014
The period				1,569,000		

[a] River frozen January 24 to February 1, also from February 14 to March 5 and from December 25 to 31.
[b] June 24 and 25 interpolated.

NORTH PLATTE RIVER NEAR BRIDGEPORT, NEBR.

This station was established May 4, 1902, by R. H. Willis. It is located at the highway bridge on the public road due north of Bridgeport. The Burlington and Missouri River Railroad bridge crosses the river 1 mile above the gaging station. The wire gage, with inclosed scale, is fastened to the upstream hand rail of the bridge at the south end. The length of the wire from the end of the weight to the marker is 12.80 feet. The gage is read once each day by Porter Hannawald. Discharge measurements are made from the upstream side of the highway bridge, which is supported by pile bents 20 feet apart. The hand rail is marked at 10-foot intervals with black paint, and the initial point for soundings is the zero mark on the hand rail at the south end of the bridge. The channel widens just above and below the station and is then straight for 1 mile above and one-half mile below. The water is never sluggish. Both banks are low and sandy, but are not liable to overflow. The bed is of shifting sand, free from vegetation. There is one channel at ordinary or high stages, but at low water the river is divided into many winding channels. The river generally goes dry in August. In sounding, during discharge measurements, care must be taken not to measure depths too close to the piles of the bridge supports, as there is usually a hole near the base of each filled with dead water. Bench mark No. 1 is a 6 by 6 inch stone, marked "U. S. C. & G. S.," located in the NE. ¼ sec. 32, T. 20 N., R. 50 W., of the sixth principal meridian. It is 300 feet east of the east gate of the stock yards and 130 feet northwest of the northwest corner of the public school building. Its elevation is 9.94 feet above gage datum. Bench mark No. 2 is a standard aluminum Geological Survey bench-mark cap set in a 20 by 12 by 6 inch stone, the top of which is built up with concrete to form a truncated pyramid. It is located about 50 feet south and a little east of the northeast corner of lot No. 4, block No. 2, of the Riverside Addition to Bridgeport, Nebr. Its elevation is 11.32 feet above gage datum. Bench mark No. 3 is the head of a nail driven in the top of the west end of the cap of the south bent of the bridge. Its elevation is 10.14 feet above gage datum. Gage datum is the water surface when the wire gage reads zero.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of North Platte River near Bridgeport, Nebr., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 2	M. D. Williams	767	1.31	5.08	1,002
April 23	J. C. Stevens	884	1.39	5.28	1,236
May 26	do	3,006	2.62	6.17	7,878
June 9	do	4,008	2.80	6.56	11,190
July 9	do	1,922	2.33	5.76	4,486
September 26	R. D. Hubbard	40	1.50	4.69	59

Mean daily gage height, in feet, of North Platte River near Bridgeport, Nebr., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.[b]
1	5.60				5.45	6.46	6.05	4.90	4.82	4.92	5.02
2	5.55				5.43	6.46	5.92	4.82	4.75	4.85	5.00
3	5.90				5.52	6.46	6.04	4.75	4.73	4.82	5.02
4	5.80				5.60	6.55	5.92	4.74	4.72	4.72	5.00
5	5.35				5.65	6.32	5.74	4.73	4.72	4.75	5.00
6	5.40				6.05	6.29	5.76	4.79	4.70	4.75	4.95
7	5.45				6.31	6.48	5.88	4.84	4.70	4.75	4.95
8	5.42				6.25	6.66	5.76	4.75	4.67	4.75	5.15
9	5.40				5.88	6.68	5.79	4.75	4.60	4.70	5.20
10	5.42			5.20	5.82	6.56	5.86	4.72	4.62	4.75	5.00
11	5.40			5.10	6.01	6.56	5.80	4.70	4.63	4.72	4.90
12	5.40			5.05	5.74	6.59	5.56	4.68	4.63	4.75	4.92
13	5.42			5.03	5.72	6.38	5.55	4.64	4.64	4.78	5.05
14	5.48			5.03	5.72	6.42	5.48	4.64	4.65	4.80	5.20
15	5.50			5.25	5.82	6.34	5.49	4.65	4.65	4.78	5.17
16	5.42			4.98	5.74	6.34	5.40	4.75	4.65	4.80	5.15
17	5.40			5.15	5.75	6.31	5.32	4.85	4.67	4.75	5.10
18	5.42			5.05	5.80	6.38	5.31	4.95	4.67	4.80	5.12
19	5.43			5.03	5.80	6.28	5.30	4.88	4.70	5.35	5.10
20	5.50			5.05	5.86	6.38	5.25	4.72	4.68	5.30	5.12
21	5.55			5.07	5.92	6.36	5.22	4.72	4.68	5.10	5.15
22	5.42			5.35	5.95	6.26	5.21	4.75	4.70	5.05	5.08
23	5.42			5.20	6.36	6.30	5.25	4.70	4.70	5.00	5.17
24				5.75	6.58	6.31	5.24	4.72	4.72	5.25	5.13
25				5.25	6.22	6.29	5.25	4.72	4.70	5.08	5.07
26				5.32	6.20	6.31	5.25	4.70	4.70	5.00	5.00
27				5.20	6.22	6.22	5.25	4.75	4.70	4.95	5.35
28				5.50	6.35	6.12	5.22	4.60	4.72	4.98	5.32
29				5.18	6.38	6.04	5.05	4.65	4.78	5.00	5.00
30				5.45	6.57	6.02	4.95	4.70	4.87	4.98	.....
31					6.50	.....	5.04	4.75	.....	5.00	.....

[a] River frozen January.
[b] Slush ice during November.

Rating table for North Platte River near Bridgeport, Nebr., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.60	50	5.20	1,200	5.80	4,800	6.30	9,000
4.70	100	5.30	1,610	5.90	5,640	6.40	9,840
4.80	200	5.40	2,090	6.00	6,480	6.50	10,680
4.90	360	5.50	2,640	6.10	7,320	6.60	11,520
5.00	580	5.60	3,280	6.20	8,160	6.70	12,360
5.10	860	5.70	4,000				

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly defined. Above gage height 5.8 feet the rating curve is a tangent, the difference being 8.40 per tenth.

Estimated monthly discharge of North Platte River near Bridgeport, Nebr., for 1904.

[Drainage area, 23,190 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 10–30	4,400	536	1,393	58,020	0.060	0.047
May	11,350	2,255	6,313	388,200	.272	.314
June	12,190	6,648	9,630	573,000	.415	.463
July	6,900	470	2,940	180,800	.127	.146
August	470	50	157	9,654	.0068	.0078
September	312	50	108	6,426	.0047	.0052
October	1,850	100	464	28,530	.020	.023
November 1–29 [a]	1,850	360	846	48,660	.036	.039
The period				1,293,000		

[a] Some slush ice in November; above estimate is for open channel. The above monthly estimate is only a rough approximation on account of insufficient measurements and shifting stream bed.

NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

The lowest gaging station on this river is located at the wagon bridge just north of North Platte, Nebr., and was established October 5, 1894. It is 3½ miles above the junction with South Platte River, in sec. 28, T. 14 N., R. 30 W. The bridge is a long, low, pile structure, having 93 spans of approximately 20 feet each, crossing the main channel of the river. North of this, at a distance of about 440 feet, is another bridge crossing a smaller branch or slough and having six spans of

about 20 feet each. The water, except in times of flood, does not pass under all of the spans of the long bridge. Usually, the greater part flows under two or three of the spans, spreading out in shallow pools or streamlets under others. Beneath the greater number of spans is a dry, sandy bed at ordinary stages. The initial point for soundings is on the right bank and consists of a mark on the railing on the upstream side of the bridge. The channel is nearly straight for about 500 feet both above and below the station. The banks are low, but are rarely, if ever, overflowed. The current is moderately rapid, and the bed is sandy and shifting.

The observations of river height are made at the Union Pacific Railroad bridge, about 2 miles below the wagon-road bridge. The railroad bridge is 2 miles above the junction of North and South Platte rivers. The gage is vertical, marked to tenths of a foot, and is fastened by screws to the piling under the bridge. The gage is read twice each day by H. E. Dress, the railroad bridge watchman.

The bench mark is the top of the east rail directly over the gage rod. Its elevation is 12.00 feet above the zero of the gage. The river usually goes dry some time in August. In measuring depths care must be taken not to sound too close to the piling, as there is usually a hole washed out around the base of each, in which there is no current.

It has been the practice, since the gage rod is some distance below the gaging section and the gage height can not be taken simultaneously with the discharge measurement, to reference the water surface both at beginning and end of the measurement to a bench mark at the gaging section, thus obtaining relative differences in the gage height for successive gagings, for a check on the height observed at the gage rod two miles below.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements on North Platte River at North Platte, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet*	*Sec. feet.*
March 26[a]	J. C. Stevens	1,000	545	2.00	2.20	1,086
May 13	do		2,030	2.46	2.80	4,995
May 27	R. D. Hubbard	1,900	3,142	3.01	3.40	9,445
June 13	J. C. Stevens		4,659	3.14	3.85	14,620
July 26	do		773	1.92	2.05	1,488
September 28	R. D. Hubbard		262	1.61	1.57	422

[a] Considerable ice running in channel. North half of channel frozen.

Mean daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	2.70	.....	2.80	2.40	2.60	3.50	2.83	1.73	1.32	2.12	2.02	2.22
2	2.50	.....	2.70	2.30	2.60	3.55	2.85	1.75	1.78	2.08	1.98	2.25
3	2.45	.....	1.50	2.30	2.58	3.65	2.98	1.90	1.48	1.98	1.95	2.25
4	2.50	.....	1.60	2.30	2.75	3.57	2.88	1.95	1.62	1.92	1.95	2.08
5	2.65	.....	1.60	2.30	2.85	3.43	2.80	1.77	1.48	1.75	1.98	2.05
6	2.70	.....	2.20	2.30	2.78	3.33	2.95	2.20	1.35	1.75	2.00	2.10
7	2.70	.....	2.35	2.00	2.63	3.30	3.13	1.85	1.30	1.78	2.00	2.12
8	2.65	.....	2.40	2.50	2.63	3.28	2.97	1.80	1.18	1.70	1.98	2.20
9	2.75	.....	2.60	2.10	3.03	3.45	3.00	1.67	1.12	1.82	1.90	2.22
10	2.80	.....	2.55	2.25	3.03	3.57	2.80	1.60	1.05	1.80	1.90	2.30
11	2.80	.....	2.45	2.10	2.93	3.60	2.92	1.55	1.05	1.78	1.92	2.30
12	2.80	.....	2.30	1.95	2.83	3.55	2.80	1.43	1.08	1.78	2.00	2.30
13	2.80	.....	2.35	2.10	2.80	3.85	2.73	1.44	1.05	1.62	2.15	2.55
14	2.80	.....	2.50	2.15	2.78	3.92	2.70	1.35	1.05	1.62	2.08	2.60
15	2.80	.....	2.50	2.10	2.73	3.75	2.68	1.30	1.08	1.62	1.98	.....
16	2.90	.....	2.40	1.95	2.68	3.75	2.50	1.27	1.05	1.65	2.02	.....
17	2.90	.....	2.40	2.05	2.75	3.60	2.40	1.23	1.05	1.65	2.15	.....
18	2.90	.....	2.35	2.00	2.75	3.50	2.35	1.25	1.05	1.85	2.10	.....
19	2.85	.....	2.25	1.85	2.68	3.50	2.25	1.25	1.00	2.08	2.10	.....
20	2.70	.....	2.30	1.90	2.68	3.45	2.40	1.20	.95	2.02	2.02	.....
21	2.70	.....	2.30	1.95	2.73	3.45	2.27	1.15	1.08	1.98	2.00	.....
22	2.80	.....	2.35	2.05	2.80	3.40	2.20	1.12	1.08	1.90	2.00	.....
23	2.80	.....	2.50	1.95	2.80	3.45	2.22	1.10	1.15	1.82	2.05	.....
24	2.80	.....	2.40	1.95	2.85	3.38	2.25	1.05	1.08	1.92	2.12	.....
25	2.80	.....	2.20	1.90	2.85	3.33	2.10	1.10	1.08	2.10	2.15	.....
26	2.75	.....	2.20	2.20	3.58	3.25	2.05	1.10	1.08	2.10	2.10	.....
27	2.65	.....	2.30	2.30	3.35	3.15	2.00	1.10	1.15	2.08	2.08	.....
28	2.60	3.75	2.40	2.30	3.25	3.05	1.95	1.10	1.40	2.08	2.05	.....
29	2.70	3.30	2.20	2.35	3.25	3.05	2.02	1.20	1.48	2.08	2.00	.....
30	2.55	.....	2.25	2.45	3.30	3.05	1.80	1.18	1.80	2.10	2.05	.....
31	.....	.....	2.40	.....	3.30	.....	1.75	1.20	.....	2.05	.....	.....

[a] Ice conditions January, February, March, and December.

Rating table for North Platte River at North Platte, Nebr., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.95	20	1.70	690	2.50	3,360	3.30	8,650
1.00	25	1.80	910	2.60	3,870	3.40	9,560
1.10	40	1.90	1,150	2.70	4,420	3.50	10,530
1.20	80	2.00	1,420	2.80	5,010	3.60	11,580
1.30	140	2.10	1,725	2.90	5,640	3.70	12,700
1.40	230	2.20	2,070	3.00	6,310	3.80	13,900
1.50	350	2.30	2,460	3.10	7,030	3.90	15,200
1.60	500	2.40	2,890	3.20	7,810	4.00	16,600

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of North Platte River at North Platte, Nebr., for 1904.

[Drainage area, 28,520 square miles.]

Month.[a]	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	3,360	1,030	1,938	115,300	0.068	0.076
May	11,370	3,768	5,644	347,000	.198	.228
June	15,480	6,670	10,260	610,500	.360	.402
July	7,264	800	3,681	226,300	.129	.149
August	2,070	32	399	24,530	.014	.016
September	910	20	159	9,461	.0056	.0062
October	1,794	538	1,167	71,760	.041	.047
November	1,898	1,150	1,517	90,270	.053	.059
The period				1,495,000		

[a] Ice conditions January, February, March, and December.

NOTE.—Insufficient measurements were made during 1904 to make the above monthly estimate other than a rough approximation.

PLATTE RIVER NEAR LEXINGTON, NEBR.

This station was established April 2, 1902, by H. O. Smith. It is located in sec. 20, T. 9 N., R. 21 W., at the highway bridge 3 miles south of Lexington, Nebr., shown on the Lexington quadrangle.

Discharge measurements are made from the upstream side of the highway bridge, which consists of 187 20-foot spans supported by pile bents. A second smaller channel, about one-fourth mile south, is measured from a similar pile bridge having a total span of 60 feet. The upstream hand rail at the main bridge is marked at 20-foot intervals. The initial point for soundings is the zero mark on the hand rail at the north or left bank of the stream. The channel is straight 1 mile above and below the station. The section is broad and shallow with a rapid velocity and shifting, sandy bed. Both banks are low but not liable to overflow. The river usually goes dry in August. At low stages the river flows in as many as 40 channels of varying widths and depths, and it is impracticable to measure the discharge at such stages with a fair degree of accuracy. It has been done, however, by preparing the channel beforehand—that is, by throwing up small dikes of sand where necessary to throw the small winding channels into ones of sufficient size to enable velocities to be measured with a current meter.

During 1902 and 1903 a single boxed-wire gage, located near the left bank, was employed for the observation of gage heights. It was

noticed, however, that on account of the extreme width—3,720 feet—and shallowness of the stream the effect of wind velocities on the gage heights was very considerable. In order to eliminate this effect as much as possible two gages of the regulation chain and weight type were installed in the spring of 1904, one at the north end downstream side and the other at the south end upstream side of bridge with their zeros at the same elevation, and Mr. E. J. Duryee, a mail carrier, was employed to read both gages in crossing, no observations being taken on Sundays or holidays. The gage heights employed in the preparation of daily discharge tables therefore are the mean of the heights observed at each gage.

Bench mark No. 2 is the top of the east end of the first cap at the north end of the bridge. Its elevation is 7.66 above gage datum. Bench marks Nos. 3 and 4 are the tops of the upstream ends of the caps of the third bent from the north and south ends of the bridge, respectively, each marked with a cross. Their elevations are respectively 9.22 and 9.03 feet above gage datum.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Platte River near Lexington, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 27	J. C. Stevens		1,708	1.80	3.34	3,070
May 14	do		2,504	1.89	3.54	4,731
May 27	do	3,793	4,656	2.28	4.10	10,610
June 14	do	3,810	6,760	2.83	4.48	19,100
July 27	do		1,046	1.61	3.32	1,690
September 1	do		83	1.50	2.99	125

Mean daily gage height, in feet, of Platte River near Lexington, Nebr., for 1904.

	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.14	.....	4.00	3.85	3.19	3.00	3.22	3.35
2	.....	3.28	3.14	4.12	3.78	3.18	3.05	.....	3.36
3	.....	.....	3.20	4.15	.....	3.25	3.02	3.32	3.34
4	.....	3.22	3.58	4.20	.....	3.20	.....	3.28	3.32
5	.....	3.20	3.70	.....	3.88	3.29	3.05	3.10	3.38
6	.....	3.29	3.60	4.11	3.78	3.18	3.02	3.18	.....
7	.....	3.32	3.56	4.05	3.88	.....	3.02	3.22	3.30
8	.....	.....	.....	4.00	3.85	3.32	2.98	3.10	3.30
9	.....	3.05	3.45	4.02	3.72	3.22	2.92	.....	3.35
10	.....	.....	3.65	4.28	.....	3.20	2.90	3.12	3.48
11	.....	3.25	3.70	4.32	3.60	3.15	.....	3.12	3.25
12	.....	3.10	3.68	.....	3.65	3.08	2.92	3.15	3.28
13	.....	3.10	3.52	4.50	3.60	3.00	3.18	3.18	.....
14	.....	2.98	3.55	4.42	3.55	.....	3.00	3.20	3.38
15	.....	3.19	.....	4.42	3.55	2.92	2.82	3.20	3.40
16	.....	3.10	.....	4.35	3.50	2.90	2.80	.....	3.35
17	.....	.....	3.50	4.48	.....	2.82	2.75	3.12	3.32
18	.....	3.06	3.55	4.25	3.40	3.22	.....	3.30	3.35
19	.....	3.02	3.55	.....	3.35	3.10	2.70	3.40	3.40
20	.....	3.08	3.52	4.24	3.40	2.92	(a)	3.35	.....
21	.....	3.06	3.45	4.20	3.40	2.88	(a)	3.38	3.35
22	.....	3.14	.....	4.22	3.38	2.68	(a)	3.35	3.35
23	.....	3.15	3.38	4.10	3.42	2.58	(a)	.....	3.35
24	.....	.....	3.50	4.16	.....	(a)	2.85	3.35	.....
25	.....	2.98	3.40	4.18	3.32	(a)	.....	3.28	3.42
26	.....	2.98	3.55	.....	3.32	(a)	2.80	3.28	3.42
27	.....	3.08	4.10	4.10	3.32	(a)	2.75	3.35	.....
28	3.32	3.20	3.88	4.00	3.32	(a)	3.15	3.30	3.45
29	3.22	3.12	.....	3.98	3.28	3.25	3.10	3.28	3.38
30	3.15	3.12	3.84	3.92	3.20	3.12	3.15	.....	3.38
31	3.18	.....	3.92	.....	.....	3.10	.....	3.32	.....

a No water flowing.

Rating table for Platte River near Lexington, Nebr., from May 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	200	3.40	2,700	3.80	6,500	4.20	12,600
3.10	750	3.50	3,500	3.90	7,700	4.30	14,700
3.20	1,350	3.60	4,400	4.00	9,100	4.40	17,000
3.30	2,000	3.70	5,400	4.10	10,700	4.50	19,500

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined. The discharge below gage height 3 feet is approximate.

Estimated monthly discharge of Platte River near Lexington, Nebr., for 1904.

[Drainage area, 53,300 square miles.]

Month.[a]	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
April[b]	2,000	1,000	1,218	72,480	0.023	0.026
May	10,700	1,025	4,295	264,100	.081	.093
June	19,500	7,700	12,570	748,000	.236	.263
July	7,700	1,350	4,071	250,300	.076	.088
August	2,000	0	760	46,730	.014	.016
September	1,350	0	266	15,830	.0050	.0056
October	2,700	750	1,662	102,200	.031	.036
November[c]	3,100	1,600	2,392	142,300	.045	.050
The period				1,642,000		

[a] Owing to the shifting condition of the stream bed and insufficient measurement during 1904 the above estimates can only be considered a very rough approximation.
[b] Daily discharge during April obtained by indirect method.
[c] November 10, river frozen; discharge estimated. Discharges for Sundays and holidays interpolated.

PLATTE RIVER NEAR COLUMBUS, NEBR.

This station was established June 4, 1895, by O. V. P. Stout, at the Meridian Bridge, 2 miles south of Columbus, Nebr. The gage is of the regulation chain and weight type, whose boxed scale is fastened to the downstream hand rail of the north bridge approach. The distance from the end of the weight to the index is 16.21 feet. The river at this point flows in three channels, known as the main, middle, and south channels, having widths of 1,940 feet, 320 feet, and 75 feet, respectively. Each channel is spanned by a pile bridge, from the upstream side of which discharge measurements are made. The main channel is crossed by the Meridian Bridge, which consists of sixty-five 30-foot spans. The middle channel bridge consists of sixteen 20-foot spans, and is located 1¼ miles south of the Meridian Bridge. The south channel is spanned by a pile bridge about 80 feet long, located one-eighth mile south of the middle channel bridge. Discharge measurements are made from the upstream side of all three bridges, whose hand rails are marked at intervals of 10 or 20 feet. The initial point for soundings is the zero mark on the upstream hand rail at the north end of the main channel bridge, and at the south ends of the middle and south channel bridges. Above the bridges the channels are straight for 5,000 feet in the main channel, 200 feet in the middle channel, and 100 feet in the south channel. Below the bridges the channels are straight for 3,000 feet in the main channel, 300 feet in the middle channel, and 500 feet in the south channel. The

sections are broad and shallow, with rapid velocity and shifting, sandy bed At low stages the river flows in many shallow channels, so that the measurement of the discharge is mainly a matter of estimation. The bed is so changeable that the daily discharges are not proportional to the corresponding gage heights. The method of applying corrections to observed gaged heights in the preparation of daily discharge tables, as outlined in Nineteenth Annual Report of the U. S. Geological Survey, Part IV, p. 323 et seq., has been resorted to. The river is usually dry from August 15 to October 15. Bench mark No. 1 is a standard iron post of the Geological Survey, located 60 feet north of the north end of the north bridge truss, and 10 feet west of a cottonwood tree 6 feet in diameter. Its elevation is 7.06 feet above the zero of the gage. Bench mark No. 2 is the heads of three spikes driven into the top of the second piling from the downstream end of the second bent from the north end of bridge, counting approach bent one. Its elevation is 9.62 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Platte River near Columbus, Nebr., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 8	J. C. Stevens	2,571	2.23	3.85	5,747
June 19	do	5,060	3.00	4.52	15,190
June 25	do	4,107	2.92	4.13	12,020
July 28	do	1,435	1.77	2.96	2,549
September 2	O. H. Timmerman	40	1.50	1.91	60

Mean daily gage height, in feet, of Platte River near Columbus, Nebr., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.20	2.60	4.15	3.91	2.53	1.87	2.05	2.40
2	.....	3.20	2.60	4.20	3.81	2.35	1.80	2.00	2.35
3	.....	3.15	2.60	4.65	3.76	2.40	1.65	1.80	2.30
4	.....	3.20	2.65	4.75	3.75	2.42	1.65	1.80	2.35
5	.....	3.20	2.65	4.85	3.75	2.32	1.70	1.25	2.35
6	.....	3.10	3.00	4.65	3.80	2.29	1.80	1.20	2.35
7	.....	3.10	.....	4.55	3.95	2.26	1.70	1.30	2.40
8	.....	3.30	3.80	4.45	4.02	2.21	1.65	2.00	2.40
9	.....	3.20	3.75	4.35	4.00	2.40	1.53	2.25	2.30
10	.....	3.05	3.75	4.10	3.85	2.85	1.46	2.45	2.20
11	.....	3.05	3.80	4.18	4.20	2.85	1.30	2.25	2.10
12	.....	3.00	3.85	4.35	3.97	2.70	1.12	2.15	2.00
13	3.20	2.90	3.85	4.90	3.80	2.52	1.55	2.20	2.20
14	3.10	2.90	3.90	5.00	3.50	2.40	1.55	2.30	2.30
15	3.10	2.80	3.60	4.60	3.42	2.25	1.35	2.40	2.30
16	3.00	2.80	3.70	4.92	3.35	2.15	1.35	2.35	2.40
17	3.00	2.75	3.60	4.80	3.70	1.95	1.35	2.35	2.55
18	3.00	2.75	3.66	4.50	3.31	2.12	1.30	2.40	2.56
19	3.00	2.70	3.65	4.52	3.20	2.15	1.30	2.45	2.45
20	3.25	2.70	3.65	4.25	3.26	2.17	1.25	2.83	2.42
21	3.30	2.65	3.60	4.20	3.27	2.08	1.50	3.10	2.40
22	3.30	2.60	3.50	4.20	3.25	1.92	1.55	3.10	2.40
23	3.30	2.60	3.38	4.10	3.17	1.65	1.40	3.25	2.40
24	3.20	2.60	3.35	4.10	3.20	1.55	1.40	2.95	2.35
25	3.10	3.00	.....	4.20	3.15	1.45	1.40	2.90	2.40
26	3.00	3.25	3.30	4.55	3.10	1.35	1.45	2.70	2.40
27	3.10	3.45	3.40	4.50	3.03	1.30	1.45	2.60	.....
28	3.10	3.20	3.60	4.25	2.95	1.35	1.50	2.40	.....
29	3.10	2.90	3.70	4.12	3.00	1.40	1.60	2.35	.....
30	3.10	2.75	4.20	4.00	2.91	1.45	1.75	2.30	.....
31	3.10	.....	4.10	.....	2.73	2.00	.....	2.35	.....

Rating table for Platte River near Columbus, Nebr., from June 15 to October 27, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	0	2.60	1,080	3.50	6,970	4.30	13,290
1.80	20	2.70	1,400	3.60	7,760	4.40	14,080
1.90	50	2.80	1,800	3.70	8,550	4.50	14,870
2.00	110	2.90	2,350	3.80	9,340	4.60	15,660
2.10	200	3.00	3,050	3.90	10,130	4.70	16,450
2.20	320	3.10	3,810	4.00	10,920	4.80	17,240
2.30	460	3.20	4,600	4.10	11,710	4.90	18,030
2.40	630	3.30	5,390	4.20	12,500	5.00	18,820
2.50	830	3.40	6,180				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is only a rough approximation. Above gage height 3.1 feet the rating curve is a tangent, the difference being 790 per tenth.

Estimated monthly discharge of Platte River near Columbus, Nebr., for 1904.[a]

[Drainage area, 56,870 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May 8–31	8,550	1,250	4,128	196,500	0.073	0.065
June	18,190	7,760	12,880	766,400	.226	.252
July	12,500	1,520	6,888	423,500	.121	.140
August	2,075	0	451	27,730	.0079	.0091
September	41	0	3.03	180	.....	.....
October	4,995	0	1,037	63,760	.018	.021
November 1–26	1,000	1,000	1,000	51,570	.018	.017
The period	.....	.....	.....	1,530,000	.....	.....

[a] Estimates May 8 to June 14 and Oct. 28 to Nov. 26 obtained by indirect method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, page 323 et seq.

BIG GRIZZLY CREEK AT HEBRON, COLO.

This station was established May 13, 1904, by M. C. Hinderlider. It is located at the highway bridge at Hebron, Colo., about 2 miles above the junction of Big and Little Grizzly creeks and 10 miles from Walden, Colo. A plain, vertical, staff gage, graduated to feet and tenths from 2 feet to 9.5 feet, is spiked to the left downstream corner of the middle crib pier. The 2-foot mark rests upon the bed of the stream. The gage is read twice each day by James R. Peterson. Discharge measurements are made at low and ordinary stages by wading near the gage. During very high water measurements are made from the downstream side of the 2-span bridge to which the gage is attached. The bridge is marked every 2 feet and figures cut every 4 feet in the top of the downstream hand rail. The initial point for soundings is the face of the left abutment at the zero marked on the hand rail. The channel is straight for about 50 feet above and below the station and the current is at right angles to the gaging section. The current is uniform and medium at all stages. Both banks are about 3 feet high, clean, and not subject to overflow. The bed of the stream is composed of gravel, with cobblestones and mud on the left side of the stream. It is fairly uniform and permanent. Bench mark No. 1 is a 30-penny nail driven vertically into the top of the downstream end of the top timber of the left abutment of the bridge. Its elevation is 9.76 feet above gage datum. Bench mark No. 2 is a regulation iron bench-mark post, 4 feet east of the fence on the west side of the road, 60 feet south of the river bank. Its elevation is 8.817 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Big Grizzly Creek at Hebron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 13[a]	W. A. Lamb	35	58	2.28	4.76	132
May 26	do	47	101	2.95	5.64	298
June 2	do	45	75	2.51	5.15	188
June 13	do	37	66	2.33	4.96	154
June 27	do	32	33	1.73	4.25	57
July 12	do	18	10	1.40	3.66	14
August 8	do	14	5	.60	3.40	3

[a] Wading 50 feet below station.

Mean daily gage height, in feet, of Big Grizzly Creek at Hebron, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		5.30	3.92	3.40	3.65	3.70
2		5.12	3.88	3.42	3.65	3.65
3		5.35	3.70	3.45	3.65	3.55
4		5.95	3.75	3.40	3.60	3.55
5		5.32	3.75	3.40	3.60	3.55
6		5.30	3.75	3.42	3.60	3.55
7		4.75	3.70	3.42	3.65	3.60
8		4.82	3.78	3.42	3.65	3.55
9		5.32	3.75	3.40	3.60	3.52
10		5.20	3.70	3.40	3.60	3.55
11		5.12	3.75	3.55	3.50	3.55
12		5.10	3.62	3.95	3.50	3.60
13	4.88	5.25	3.58	3.90	3.50	3.65
14	4.82	5.25	3.58	3.90	3.50	3.70
15	4.85	5.22	3.62	3.90	3.40	3.75
16	4.85	5.00	3.58	4.00	3.40	3.70
17	4.72	4.95	5.48	3.95	3.40	3.70
18	4.80	4.80	3.52	3.95	3.40	3.75
19	4.90	4.95	3.50	3.90	3.45	3.75
20	4.98	4.95	3.50	3.75	3.45	3.70
21	5.30	4.68	3.50	3.70	3.50	3.70
22	5.35	4.75	3.50	3.60	3.50	3.70
23	5.35	4.58	3.50	3.60	3.55	3.75
24	5.58	4.50	3.50	3.60	3.55	3.75
25	5.55	4.45	3.50	3.60	3.55	3.70
26	5.68	4.38	3.48	3.60	3.75	3.70
27	5.72	4.20	3.50	3.60	3.55	3.70
28	5.52	4.10	3.50	3.60	3.56	3.75
29	5.45	4.00	3.48	3.60	3.60	3.60
30	5.35	3.90	3.45	3.65	3.65	3.60
31	5.35		3.45	3.62		3.60

Rating table for Big Grizzly Creek at Hebron, Colo., from May 13 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	3	4.10	43	4.80	127	5.50	264
3.50	7	4.20	52	4.90	143	5.60	288
3.60	11	4.30	62	5.00	160	5.70	313
3.70	16	4.40	73	5.10	178	5.80	339
3.80	22	4.50	85	5.20	198	5.90	366
3.90	28	4.60	98	5.30	219	6.00	394
4.00	35	4.70	112	5.40	241		

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined to gage height 5.6 feet. The table has been extended above this limit.

Estimated monthly discharge of Big Grizzly Creek at Hebron, Colo., for 1904.

Month.	Discharge in second feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 13–31	318	115	207	7,801
June	380	28	152	9,045
July	29	5	12.0	738
August	35	3	14.1	867
September	13	3	8.73	519
October	19	8	13.7	842
The period				19,820

LITTLE GRIZZLY CREEK NEAR HEBRON, COLO.

This station was established June 3, 1904, by William A. Lamb. It is located at the wagon bridge on James Hill's ranch, one-half mile southwest of Hebron, Colo., and one-fourth mile west of the road from Hebron to Spicer. A plain staff gage is nailed vertically to the northwest corner of the center pier of the bridge. It is read twice each day by John Peterson. At low water measurements are made by wading 300 feet above the gage. At high water measurements are made from the downstream side of the 2-span bridge to which the gage is attached. The initial point for soundings is the east edge of the pier at the left bank. Points for sounding are marked every 2 feet by 10-penny nails driven into the guard rail on the downstream side of the bridge. The channel is straight for about 150 feet above and below the station, and the current has a medium and uniform

velocity. Both banks are low, and liable to overflow. The right bank is partly covered by willows. The bed of the stream is composed of gravel and is firm. There is but one channel at all stages, broken by the middle pier of the bridge. Bench mark No. 1 is a nail driven into the north end of the second log in the left abutment. Its elevation is 5.90 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the north end of a log in the right abutment. Its elevation is 6.373 feet above the zero of the gage. Bench mark No. 3 is the top of a regulation iron bench-mark post, 80 feet east of the gage rod and 20 feet north of the road. Its elevation is 6.786 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Little Grizzly Creek near Hebron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 3	W. A. Lamb	47	117	2.53	4.85	296
June 13	do	47	159	3.45	5.60	548
June 27	do	46	98	1.91	4.22	187
July 12	do	28	17	2.18	3.05	37
August 8	do	10	11	1.09	2.80	12
September 12[a]	do	15	6	1.33	2.73	8

[a] Wading 300 feet above station.

Mean daily gage height, in feet, of Little Grizzly Creek near Hebron, Colo., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	.....	4.00	2.90	2.90	2.80	17	4.95	2.92	3.00	2.70	2.80
2	.....	3.85	2.90	2.90	2.85	18	4.65	2.95	3.00	2.70	2.80
3	4.82	3.78	2.80	2.80	2.80	19	4.72	2.90	2.85	2.70	2.80
4	4.52	3.85	2.80	2.80	2.80	20	4.68	2.90	2.90	2.70	2.88
5	4.05	3.72	2.80	2.82	2.85	21	4.78	2.80	2.90	2.70	2.85
6	3.92	3.62	2.80	2.85	2.85	22	4.80	2.90	2.85	2.75	2.90
7	4.25	3.50	2.80	2.85	2.80	23	4.48	2.90	2.85	2.75	2.92
8	4.45	3.40	2.80	2.85	2.80	24	4.62	2.90	2.90	2.75	2.95
9	4.88	3.30	2.80	2.80	2.80	25	4.30	2.90	2.90	2.75	2.90
10	4.78	3.20	2.80	2.80	2.80	26	4.22	2.85	2.90	2.75	2.85
11	4.90	3.25	2.85	2.80	2.78	27	4.20	2.90	2.85	2.75	2.80
12	5.35	3.05	2.90	2.75	2.75	28	4.10	2.90	2.85	2.75	2.85
13	5.40	3.00	2.90	2.75	2.80	29	3.95	2.90	2.85	2.80	2.80
14	5.45	3.00	2.90	2.70	2.80	30	4.02	2.95	2.82	2.80	2.80
15	5.15	3.00	2.85	2.70	2.80	31	.....	2.95	2.92	.....	2.82
16	5.15	3.00	2.95	2.70	2.85						

Rating table for Little Grizzly Creek near Hebron, Colo., from June 3 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	7	3.30	61	4.10	162	4.90	322
2.75	9	3.40	71	4.20	180	5.00	347
2.80	12	3.50	82	4.30	198	5.10	375
2.85	16	3.60	94	4.40	216	5.20	405
2.90	21	3.70	106	4.50	235	5.30	438
2.95	26	3.80	119	4.60	255	5.40	472
3.00	31	3.90	133	4.70	276	5.50	509
3.10	41	4.00	147	4.80	298	5.60	548
3.20	51						

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined.

Estimated monthly discharge of Little Grizzly Creek near Hebron, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 3–30	490	136	27.2	15,110
July	147	12	49.0	3,013
August	31	12	18.0	1,107
September	21	7	10.8	643
October	26	9	14.5	892
The period				20,760

ROARING FORK RIVER NEAR HEBRON, COLO.

This station was established May 14, 1904, by M. C. Hinderlider. It is located at the highway bridge, about 2 miles above J. E. Mallon's ranch house and 4 miles northwest of Hebron, Colo., and is one-half mile above the mouth of the river. A standard chain gage was placed June 14, 1904, by William A. Lamb. It is located on the east side of the bridge, 18 feet from the south face of the north abutment. The length of the chain from the end of the weight to the marker is 7.70 feet. The gage is read three times each week by Walter Johnson. Discharge measurements are made at low stages by wading near the gage. At higher stages they are made from the single-span bridge to which the gage is attached, sounding points being marked on the downstream side with figures cut in the floor. The initial point for soundings is the south face of the north abutment, marked with a spike driven into the bridge floor. The channel is straight for about

100 feet above and 50 feet below the station, and the current is uniform and moderately swift. Both banks are about 5 feet high above and 3 feet high below the bridge, lined with willows, and not liable to overflow except at extremely high stages. The bed of the stream is composed of coarse gravel and cobblestones, uniform and stable. There is but one channel at all stages. Bench mark No. 1 is the top of a spike driven horizontally into the east end of the second timber from the top of the north abutment. The head of a nail driven vertically into the north end of the gage rod is 2.55 feet above this bench mark. The elevation of the bench mark is 2.86 feet above gage datum. Bench mark No. 2, established October 2, 1904, is the top of a cast-iron rod, 16 inches long by 1 inch at the lower end, tapering to a point at the upper end. It is set on a bowlder sunken in the ground by the side of the lane fence, 50 feet northeast of the north pier of the bridge. Its elevation is 7.14 feet above the gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Roaring Fork River near Hebron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 14	W. A. Lamb	36	31	2.65	.....	82
May 27	do	42	90	3.64	3.49	328
June 4	do	41	65	3.42	3.04	222
July 13	do	34	37	2.95	2.00	109
August 9	do	25	23	1.69	1.60	39
September 13[a]	do	18	15	1.00	1.32	15

[a] Measured at different section.

Mean daily gage height, in feet, of Roaring Fork River near Hebron, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.60	1.15	1.30	.....	17	.....	1.15	1.30	1.35	.....
2	.....	.....	.....	.....	1.30	18	.....	.....	.....	.....	.....
3	.....	1.75	1.65	1.30	.....	19	.....	.....	1.30	.....	.....
4	.....	.....	.....	.....	.....	20	2.03	1.20	.....	1.30	.....
5	.....	.....	1.20	.....	1.30	21	.....	.....	1.25	.....	.....
6	.....	1.65	.....	1.30	.....	22	.....	1.20	1.30	1.30	.....
7	.....	.....	.....	.....	.....	23	2.01	.....	.....	.....	.....
8	.....	1.75	1.20	1.30	.....	24	.....	.....	1.30	1.30	.....
9	.....	.....	.....	.....	.....	25	2.00	1.25	.....	.....	.....
10	.....	1.55	1.25	1.30	.....	26	.....	.....	1.30	1.25	.....
11	.....	.....	.....	.....	.....	27	.....	1.20	.....	.....	.....
12	.....	.....	1.25	1.30	.....	28	1.95	.....	.....	.....	.....
13	.....	1.25	.....	1.30	.....	29	.....	1.15	1.30	1.30	.....
14	.....	.....	.....	.....	.....	30	1.80	.....	.....	.....	.....
15	.....	1.02	1.30	1.40	.....	31	.....	.....	.....	1.30	.....
16	.....	.....	.....	.....	.....						

Rating table for Roaring Fork River near Hebron, Colo., from May 14 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	2	1.30	13	1.60	40	1.90	72
1.05	3	1.35	17	1.65	45	1.95	78
1.10	4	1.40	21	1.70	50	2.00	84
1.15	5	1.45	25	1.75	55	2.10	96
1.20	7	1.50	30	1.80	60		
1.25	10	1.55	35	1.85	66		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of Roaring Fork River near Hebron, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July, 5 days	88	60	79.0	[a] 1,880
August, 13 days	55	2	21.8	[b] 1,340
September, 14 days	13	5	10.4	[b] 619
October, 15 days	21	10	13.6	[b] 836

[a] Acre-feet computed July 20–31. [b] Acre-feet computed for full month.

MICHIGAN CREEK NEAR WALDEN, COLO.

This station was established May 9, 1904, by M. C. Hinderlider. It is located at the highway bridge, one-half mile east of Walden, Colo. A plain, vertical, staff gage is attached to the left downstream corner of the middle pier. The gage is graduated to feet and tenths from 4 to 10 feet, the 4-foot mark resting on the bed of the stream at the foot of the pier. It is read twice each day by J. K. P. McCallum. Discharge measurements are made at ordinary stages by wading a short distance above the two-span bridge to which the gage is attached. At high stages they are made from the downstream side of the bridge. The initial point for soundings is a 30-penny nail driven into the floor at the west end of the bridge. The channel is straight for about 75 feet above and 50 feet below the station. The current is medium at low and swift at high stages. Both banks are about three feet high, bordered by flat meadow lands, and are not liable to overflow. The bed of the stream is composed of sand and gravel, free from vegetation, and is fairly permanent. Bench mark No. 1 is the top of a nail driven into the left abutment of the bridge on the downstream side. Its elevation is 7.910 feet above the gage datum. Bench mark No. 2 is the top of a 20-penny nail driven into the top of a sandstone bowlder

under the cliff on the north side of the river, about 275 feet northeast of the east end of the bridge. It is marked "B. M. U. S. G. S." Its elevation is 15.335 feet above the gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Michigan Creek near Walden, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 8[a]	W. A. Lamb	40	37	3.32	4.95	123
May 24	do	72	79	3.29	5.41	260
June 1	do	40	90	3.07	5.51	276
July 9	do	56	85	2.33	5.28	198
August 6	do	28	23	2.17	4.70	50
August 22	do	29	28	2.64	4.77	74
September 6[a]	do	26	18	2.00	4.60	36
October 28[a]	do	25	15	2.20	4.60	33

[a] Wading at different section.

Mean daily gage height, in feet, of Michigan Creek near Walden, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	5.48	5.50	4.80	4.70	4.55
2	.....	5.45	5.42	4.78	4.88	4.50
3	.....	5.60	5.40	4.75	4.75	4.50
4	.....	5.62	5.35	4.70	4.70	4.50
5	.....	5.45	5.32	4.70	4.68	4.50
6	.....	5.38	5.25	4.70	4.68	4.50
7	.....	5.38	5.28	4.70	4.60	4.52
8	.....	5.45	5.28	4.70	4.60	4.55
9	4.88	5.58	5.28	4.65	4.60	4.55
10	4.95	5.60	5.12	4.65	4.60	4.55
11	5.22	5.65	5.10	4.70	4.55	4.60
12	5.05	5.62	5.10	4.78	4.55	4.55
13	4.75	5.68	5.05	4.72	4.55	4.60
14	5.00	5.78	5.05	4.70	4.50	4.58
15	5.00	5.88	5.02	4.70	4.50	4.55
16	5.02	5.90	4.98	4.75	4.50	4.55
17	4.95	5.85	4.75	4.85	4.50	4.55
18	4.90	5.80	4.98	4.80	4.50	4.55
19	4.98	5.70	4.90	4.82	4.50	4.55
20	5.15	5.68	4.90	4.78	4.50	4.60
21	5.20	5.68	4.90	4.75	4.50	4.60
22	5.20	5.72	4.90	4.78	4.50	4.60
23	5.30	5.68	4.90	4.70	4.60	4.60
24	5.30	5.68	4.90	4.68	4.52	4.60
25	5.50	5.62	4.90	4.62	4.50	4.60
26	5.60	5.50	4.82	4.60	4.52	4.60
27	5.62	5.48	4.80	4.68	4.58	4.65
28	5.45	5.35	4.82	4.70	4.55	4.60
29	5.35	5.35	4.90	4.70	4.55	4.60
30	5.42	5.38	4.92	4.70	4.60	4.60
31	5.40	.....	4.82	4.65	.....	4.60

Rating table for Michigan Creek near Walden, Colo., from May 8 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.50	17	4.75	60	5.00	118	5.50	280
4.55	24	4.80	71	5.10	145	5.60	321
4.60	32	4.85	82	5.20	174	5.70	364
4.65	41	4.90	94	5.30	207	5.80	411
4.70	50	4.95	106	5.40	242	5.90	460

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 4.6 feet and 5.5 feet.

Estimated monthly discharge of Michigan Creek near Walden, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 9–31	329	60	177	8,073
June	460	224	320	19,040
July	280	60	137	8,424
August	82	32	54.3	3,339
September	89	17	29.7	1,767
October	41	17	26.8	1,648
The period				42,290

MICHIGAN CREEK, OR MIDDLE FORK RIVER, NEAR COWDREY, COLO.

This station was established May 9, 1904, by M. C. Hinderlider. It is located 100 feet above the wagon bridge, 1½ miles northwest of Cowdrey, Colo. The gage is an inclined staff, graduated vertically to feet and tenths, spiked firmly to posts set into the left bank. The distance between the footmarks on the slope is 1.6 feet. The gage is read twice each day by L. L. Knoles. Discharge measurements are made at all ordinary stages by wading near the gage. At extreme high-water measurements are made from the wagon bridge 100 feet below the gage rod. The initial point for soundings is the top of the left bank at the gage. The channel is straight for about 50 feet above and 100 feet below the station, and the current is medium. The right bank is a gradually sloping gravel bar and overflows at high water for about 80 feet. The left bank is about 2.5 feet high, sodded, and does not overflow. The bed of the stream is composed of gravel, free from vegetation, uniform, and permanent. Bench mark No. 1 is a 30-penny

nail driven into the top of the south end of the cap timber of the first pile bent at the east end of the bridge. A witness nail is driven beside it. The elevation of the bench mark is 6.23 feet above the zero of the gage. Bench mark No. 2 is the top of an iron post located 3 feet south of the fence on the south side of the road, 75 feet north of the gage rod and 50 feet west of the river bank. Its elevation is 6.255 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 7	W. A. Lamb	54	97	2.71	3.30	264
June 10	do	53	157	2.41	3.55	379
June 17	do	56	177	2.58	4.02	456
June 29[a]	do	42	69	3.06	3.05	211
August 3	do	36	33	2.24	2.30	74
August 22	do	38	41	2.22	2.44	91
September 6[a]	do	39	34	1.47	2.20	50
September 24[a]	do	28	17	1.76	2.00	30

[a] Wading at different section.

Mean daily gage height, in feet, of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		3.32	3.20	2.38	2.30	2.00
2		3.30	3.28	2.35	2.36	2.00
3		3.65	3.20	2.32	2.42	2.00
4		4.02	3.20	2.25	2.30	1.95
5		3.80	3.10	2.22	2.22	1.90
6		3.40	3.20	2.22	2.20	1.90
7		3.20	3.40	2.20	2.12	1.90
8		3.30	3.80	2.20	2.05	1.90
9		3.45	3.12	2.15	2.00	2.00
10		3.52	2.98	2.12	2.00	2.00
11		3.48	2.92	2.15	2.00	2.00
12	2.35	3.52	2.80	2.20	2.00	2.00
13	2.30	3.52	2.80	2.25	2.00	2.00
14	2.28	3.62	2.75	2.25	2.00	2.00
15	2.20	3.78	2.58	2.20	1.95	2.00
16	2.22	3.98	2.50	2.20	1.90	2.00
17	2.20	4.05	2.50	2.45	1.90	2.05
18	2.12	3.90	2.40	2.50	1.90	2.00
19	2.10	3.80	2.38	2.50	1.88	2.00
20	2.18	3.70	2.35	2.50	1.90	2.00
21	2.35	3.70	2.35	2.40	1.95	2.00
22	3.05	3.60	2.38	2.40	1.95	2.00
23	2.68	3.60	2.32	2.38	2.00	2.00
24	2.90	3.65	2.38	2.38	2.00	2.00
25	3.22	3.65	2.40	2.28	1.98	2.00
26	3.65	3.45	2.40	2.10	1.95	2.00
27	3.80	3.20	2.32	2.12	2.00	2.00
28	3.55	3.05	2.35	2.20	2.00	2.00
29	3.28	3.00	2.40	2.22	2.00	2.00
30	3.18	3.00	2.45	2.25	2.00	2.00
31	3.18	.....	2.45	2.28	.....	2.00

Rating table for Michigan Creek, or Middle Fork River, near Cowdrey, Colo., from May 12 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	19	2.40	86	3.00	200	3.60	353
1.95	24	2.50	103	3.10	221	3.70	384
2.00	29	2.60	121	3.20	245	3.80	417
2.10	42	2.70	140	3.30	270	3.90	451
2.20	56	2.80	160	3.40	296	4.00	489
2.30	70	2.90	180	3.50	323	4.10	530

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 2 feet and 3.5 feet.

Estimated monthly discharge of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 12–31	417	42	162	6,427
June	509	200	342	20,350
July	296	73	148	9,100
August	103	42	67.9	4,175
September	89	17	35.6	2,118
October	35	19	27.7	1,703
The period				43,870

CANADIAN CREEK NEAR COWDREY, COLO.

This station was established May 10, 1904, by M. C. Hinderlider. It is located at the highway bridge one-half mile east of Cowdrey, Colo. A plain, vertical, staff gage is attached to the west face of the first pile from the left bank on the downstream side of the bridge. The gage is graduated to feet and tenths from 2 feet to 8 feet, the 2-foot mark resting on the bed of the stream. It is read twice each day by L. L. Knoles. Discharge measurements are made at all normal stages by wading a short distance above the bridge to which the gage is attached. At exceedingly high stages measurements are made from the bridge, which is marked every 2 feet on the downstream guard rail. The initial point for soundings is a 20-penny nail driven into the floor of the bridge over the face of the left abutment on the downstream side. The channel is straight for about 150 feet above and 40 feet below the station, and the current is uniform and of medium velocity. Both banks are about 2 feet high, bordered with willows and bushes above the bridge, and clean below. The left bank overflows at extreme high stages of the stream. The bed of the stream is composed of sand and silt, with a few stones from the riprap at the west end of the bridge, and is shifting. There is but one channel at all stages, broken by four pile bents. Bench mark No. 1 is a 30-penny spike nail driven flush with the top of the cap timber above the gage rod. Its elevation is 9.80 feet above the gage datum. Bench mark No. 2 is a 30-penny nail driven horizontally into the north face of a telephone pole, 3 feet above the ground, 60 feet south of the left end of the bridge. Its elevation is 9.80 feet above the datum of the gage. Bench mark No. 3 is a regulation iron bench-mark post, 3 feet south of the fence on the north side of the road, 40 feet west of the gage rod. Its elevation is 8.02 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Canadian Creek near Cowdrey, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 10[a]	W. A. Lamb	21	38	1.74	4.68	66
May 24	do	37	58	1.87	5.18	105
May 31	do	57	68	1.72	5.15	117
June 7	do	54	79	2.15	5.20	170
June 11	do	54	89	2.75	5.45	244
June 30[a]	do	23	33	2.03	4.73	67
July 8	do	33	52	2.00	5.00	104
August [illegible]	do	28	19	1.42	4.30	27
August 22	do	23	22	1.59	4.42	35
September 5	do	27	17	1.06	4.22	18

[a] Wading at different section.

Mean daily gage height, in feet, of Canadian Creek near Cowdrey, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	5.20	4.85	4.42	4.30	4.25
2	.....	5.15	5.10	4.40	4.30	4.20
3	.....	5.40	4.95	4.32	4.40	4.20
4	.....	5.90	4.95	4.30	4.32	4.20
5	.....	5.45	4.92	4.30	4.25	4.20
6	.....	5.22	4.80	4.28	4.20	4.20
7	.....	5.15	4.98	4.25	4.20	4.15
8	.....	5.25	4.98	4.28	4.20	4.10
9	.....	5.55	4.90	4.20	4.20	4.10
10	.....	5.45	4.68	4.20	4.20	4.10
11	.....	5.40	4.62	4.15	4.20	4.10
12	4.68	5.45	4.55	4.20	4.15	4.10
13	4.70	5.38	4.50	4.20	4.10	4.10
14	4.70	5.38	4.52	4.15	4.10	4.10
15	4.70	5.42	4.62	4.25	4.10	4.10
16	4.70	5.45	4.55	4.30	4.10	4.10
17	4.72	5.40	4.60	4.40	4.10	4.20
18	4.58	5.38	4.78	4.50	4.10	4.20
19	4.55	5.42	4.50	4.50	4.15	4.20
20	4.62	5.25	4.48	4.50	4.12	4.20
21	5.00	5.28	4.50	4.40	4.10	4.20
22	5.08	5.15	4.50	4.40	4.20	4.20
23	5.05	5.10	4.48	4.32	4.20	4.20
24	5.15	5.10	4.48	4.30	4.20	4.20
25	5.32	5.10	4.55	4.28	4.20	4.20
26	5.45	5.00	4.52	4.22	4.20	4.20
27	5.48	4.88	4.50	4.28	4.28	4.20
28	5.30	4.78	4.52	4.25	4.30	4.20
29	5.10	4.72	4.58	4.22	4.30	4.20
30	5.02	4.70	4.58	4.28	4.25	4.20
31	5.10	.....	4.58	4.30	.....	4.20

Rating table for Canadian Creek near Cowdrey, Colo., from May 10 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.10	10	4.40	33	4.70	66	5.00	110
4.15	13	4.45	38	4.75	72	5.10	131
4.20	17	4.50	43	4.80	78	5.20	157
4.25	21	4.55	48	4.85	85	5.30	188
4.30	25	4.60	54	4.90	93	5.40	223
4.35	29	4.65	60	4.95	101	5.50	265

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is well defined between gage heights 4.2 feet and 5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Canadian Creek near Cowdrey, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 12–31	256	48	116	4,602
June	288	66	189	11,250
July	131	41	63.7	3,917
August	43	13	25.3	1,556
September	33	10	17.3	1,029
October	21	10	15.0	922
The period				23,280

LARAMIE RIVER NEAR GLENDEVEY, COLO.

This station was established June 24, 1904, by William A. Lamb. It is located at the highway bridge one-eighth mile west of Glendevey, Colo., on the State road between Walden and Fort Collins. A plain staff gage is attached to the northwest corner of the first pier from the right bank. It is read twice each day by W. W. Summers. Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. Points for soundings are marked by numbers painted at intervals of 2 feet on the floor of the bridge. The initial point for soundings is a 30-penny nail driven into the guard log directly over the east face of the wooden pier at the left end of the bridge. The channel is straight for about 200 feet above and 300 feet below the station, and the current is swift at all stages. Both banks are high, wooded, and not liable to overflow. The bed of the stream is covered with bowlders and coarse gravel, free from vegeta-

tion, and permanent. There is one channel at all stages, broken by three piers. Bench mark No. 1 is a cross cut in the top of a granite bowlder, 18 inches in diameter, located 10 feet northwest of the initial point for soundings. Its elevation is 7.325 feet above the zero of the gage. Bench mark No. 2 is a cross cut in the top of a granite bowlder, 3 feet in diameter, located 75 feet northwest of the initial point for soundings. Its elevation is 16.841 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Laramie River near Glendevey, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 24 [a]	W. A. Lamb	54	86	4.83	3.00	415
July 5 [a]	do	61	67	3.66	2.60	245
August 2 [a]	do	32	36	2.53	2.15	91
August 20	do	35	34	1.94	2.08	66
September 4	do	32	30	1.80	2.00	54
October 24	do	25	22	1.45	1.85	32

[a] Measurements June 24, July 5, and Aug. 2 are probably several per cent too large on account of defective meter.

Mean daily gage height, in feet, of Laramie River near Glendevey, Colo., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	.....	3.00	2.12	2.00	2.00	17	.....	2.30	2.10	1.90	2.00
2	.....	2.68	2.10	2.00	2.00	18	.....	2.28	2.15	1.90	2.00
3	.....	2.62	2.10	2.00	2.00	19	.....	2.25	2.08	1.90	2.00
4	.....	2.62	2.10	2.00	1.90	20	.....	2.22	2.05	1.90	1.90
5	.....	2.60	2.10	2.00	1.90	21	.....	2.22	2.05	1.90	1.90
6	.....	2.60	2.05	2.00	1.90	22	.....	2.22	2.05	1.90	1.90
7	.....	2.60	2.05	1.98	1.90	23	.....	2.20	2.00	1.90	1.90
8	.....	2.70	2.05	1.92	1.90	24	3.00	2.20	2.00	1.90	1.90
9	.....	2.52	2.08	1.90	1.90	25	2.75	2.20	2.00	1.90	1.90
10	.....	2.38	2.05	1.90	1.90	26	2.72	2.20	2.00	1.90	1.85
11	.....	2.42	2.00	1.90	1.90	27	2.72	2.18	2.00	1.90	1.80
12	.....	2.40	2.10	1.90	1.90	28	2.65	2.20	2.00	1.90	1.80
13	.....	2.38	2.08	1.90	1.90	29	2.65	2.20	2.00	1.90	1.80
14	.....	2.30	2.05	1.90	1.90	30	2.65	2.15	2.00	2.00	1.80
15	.....	2.30	2.05	1.90	1.90	31	.....	2.15	2.00	.....	1.80
16	.....	2.30	2.10	1.90	1.90						

LARAMIE RIVER NEAR JELM, WYO.

This station was established June 22, 1904, by W. A. Lamb. It is located at the wagon bridge at H. T. Decker's ranch, one-half mile south of the Colorodo-Wyoming State line, near Jelm, Wyo. A plain

staff gage, graduated to feet and tenths, is fastened in a vertical position to the northwest corner of the center pier of the bridge. The gage is read twice each day by H. T. Decker. Discharge measurements are made from the downstream side of the four-span bridge, to which the gage is attached. The initial point for soundings is a 30-penny nail driven into the left end of the downstream guard rail. The channel is straight for about 50 feet above and 300 feet below the station, and the current is swift. Both banks are high, covered with willows, and not subject to overflow. The bed of the stream is composed of gravel and bowlders, and is firm. There is but one channel at all stages, broken by the three piers of the bridge. The bench mark is a 30-penny nail driven into the lower log at the southwest corner of H. T. Decker's house. Its elevation is 12.35 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Laramie River near Jelm, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 22[a]	W. A. Lamb	60	146	5.37	4.30	784
July 6[a]	do	52	112	4.33	3.40	492
August 2[a]	do	44	63	2.22	2.30	140
August 20	do	44	59	1.83	2.25	108
October 27	do	44	37	1.33	2.00	49

[a] Measurements June 22, July 6, and Aug. 2 in error by several per cent owing to defective meter.

Mean daily gage height, in feet, of Laramie River near Jelm, Wyo., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	.....	3.85	2.30	2.10	1.90	17	.....	2.50	2.40	1.90	2.00
2	.....	3.45	2.30	2.10	1.90	18	.....	2.50	2.45	1.90	2.00
3	.....	3.30	2.30	2.10	1.90	19	.....	2.45	2.35	1.90	2.00
4	.....	3.35	2.30	2.10	1.90	20	.....	2.40	2.30	1.90	2.00
5	.....	3.20	2.30	2.05	1.90	21	.....	2.35	2.30	1.90	2.00
6	.....	3.25	2.20	2.00	1.90	22	4.20	2.45	2.25	1.90	2.00
7	.....	3.20	2.20	2.00	1.90	23	4.10	2.40	2.20	1.90	2.00
8	.....	3.40	2.20	2.00	1.90	24	4.15	2.40	2.10	2.00	2.00
9	.....	3.05	2.20	2.00	2.00	25	3.82	2.50	2.10	2.00	2.00
10	.....	2.75	2.15	2.00	2.00	26	3.60	2.40	2.10	2.00	2.00
11	.....	2.75	2.10	1.90	2.00	27	3.60	2.40	2.10	2.00	2.00
12	.....	2.65	2.15	1.90	2.00	28	3.40	2.40	2.10	2.05	2.00
13	.....	2.55	2.10	2.00	2.00	29	3.25	2.40	2.10	2.00	2.00
14	.....	2.60	2.20	2.00	2.00	30	3.25	2.40	2.10	2.00	2.00
15	.....	2.50	2.20	1.90	2.00	31	.....	2.30	2.10	.....	2.00
16	.....	2.45	2.20	1.90	2.00						

M'INTYRE CREEK AT GLENEYRE, COLO.

This station was established June 23, 1904, by W. A. Lamb. It is located at the wagon bridge on Smith's ranch at Gleneyre, Colo. A plain staff gage is attached vertically to a post which is driven into the bed of the stream and fastened to the left end of the bridge. It is read twice each day by Elbert E. Smith. Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The initial point for soundings is at the edge of the gage rod. The channel is straight for about 200 feet above and 30 feet below the station, and the current is swift at all stages. The right bank is low, partly covered with willows, and is liable to overflow. The left bank is high, covered with willows, and does not overflow. The bed of the stream is composed of gravel and small bowlders and is firm. The bench mark is the top of an iron rod three-fourths inch in diameter and 2½ feet long, with an L-shaped bend at the lower end, resting on a granite bowlder, 14 inches in diameter, which is set 2 feet under ground, 30 feet northeast of the gage. Its elevation is 5.308 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of McIntyre Creek at Gleneyre, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 23	W. A. Lamb	32	49	3.51	2.98	172
July 6	do	28	32	2.81	2.38	90
August 2	do	12	18	1.17	1.75	21
August 20	do	12	17	1.06	1.76	18
September 4	do	11	14	.86	1.65	12
October 26[a]	do	11	14	.79	1.60	11

[a] Wading 50 feet below station.

Mean daily gage height, in feet, of McIntyre Creek at Gleneyre, Colo., for 1904.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	2.95	1.85	2.00	17	.....	2.05	1.85	1.85
2	.....	2.80	1.85	1.90	18	.....	2.05	1.85	1.85
3	.....	2.60	1.82	1.90	19	.....	2.08	1.85	1.85
4	.....	2.35	1.82	1.90	20	.....	2.05	2.10	1.85
5	.....	2.55	1.78	1.90	21	.....	1.95	1.92	1.85
6	.....	2.30	1.72	1.85	22	.....	1.92	2.00	1.85
7	.....	2.48	1.72	1.85	23	.....	1.85	1.90	1.85
8	.....	2.65	1.75	1.85	24	3.05	1.92	1.88	1.85
9	.....	2.38	1.75	1.85	25	2.92	1.92	1.85	1.88
10	.....	2.35	1.78	1.85	26	2.92	1.85	1.85	1.90
11	.....	2.30	1.80	1.85	27	2.85	1.85	1.85	1.85
12	.....	2.22	1.80	1.85	28	2.82	1.85	1.85	1.85
13	.....	2.10	1.80	1.85	29	2.85	1.85	1.90	1.85
14	.....	2.10	1.85	1.85	30	2.92	1.88	1.85	1.85
15	.....	2.09	1.85	1.85	31	.....	1.85	1.85	.....
16	.....	2.05	2.00	1.85					

Rating table for McIntyre Creek at Gleneyre, Colo., from June 24 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	8	1.85	30	2.20	68	2.70	133
1.65	12	1.90	35	2.30	80	2.80	147
1.70	16	1.95	40	2.40	92	2.90	161
1.75	20	2.00	45	2.50	105	3.00	176
1.80	25	2.10	56	2.60	119	3.10	192

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined.

Estimated monthly discharge of McIntyre Creek at Gleneyre, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 24–30	184	150	162	2,249
July	168	50	66.2	4,070
August	56	18	29.9	1,838
September	45	30	31.4	1,868

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station is located at the junction of the North and South forks of South Platte River, at the town of South Platte, located on the Colorado and Southern Railroad, about 9 miles above the mouth of

the canyon. The station was established March 28, 1902, by John E. Field, at the wagon bridge crossing the main stream about 150 feet below the junction of the two forks. This station is of special importance, its location being above the diverting gates of all irrigating ditches, and also above the intake of the Denver Union Water Company, which derives the greater part of its supply of water from South Platte River a few miles below this station. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the contemplated installation of large power plants of the two forks above, also add to the importance of this station as a point from which to secure data. Bridges across either fork above the main station allow of measurements being made on these streams, thereby checking all gagings on the main stream below. This station is located only about 200 feet from the Colorado and Southern Railroad station and is easily accessible from Denver. The gage is a vertical 2 by 6 inch pine timber reading from zero to 7 feet and is fastened to the upper side of the center pier of the highway bridge. When the gage reads 2.3 feet or less, measurements are made by wading about 250 feet below the bridge. At high water discharge measurements are made from the lower side of the two-span highway bridge to which the gage is attached.

The gage is read twice each day by Mrs. Mata Wallbrecht, postmistress. The initial point for soundings is the river face of the right abutment. The channel is straight for 250 feet above and 400 feet below the station. The current is rough and rapid beneath the bridge, but becomes more even below. The right bank is the side of the mountain. The left bank, at ordinary stages, is part of the old river bed, about 100 feet wide. At extremely high water the Colorado and Southern Railroad roadbed is the left bank. At the bridge the river is divided into two channels by the center pier. The right channel is the deeper and carries most of the water. An old abutment foundation directly under the left end of the bridge interferes with the current during high stages. The bench mark is a nail driven horizontally in the right side of the upper end of a 12 by 12 inch cap timber on top of the middle pier of the bridge. It is inclosed in a circle of white paint and has four other nails driven about it. It is directly over the gage rod and has an elevation of 10.15 feet above the zero of the gage. Bench mark No. 2 is a regulation metal tablet in the cliff about 75 feet from the south end of the bridge. The elevation is 18.43 feet above zero of gage.

During the floods of 1904 both bridges on the North and South forks were carried away, which prevents high water measurements being made on either fork.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of South Platte River at South Platte, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 17[a]	R. I. Meeker	28	29	1.62	1.05	47
March 28[a]	O. McDermith	30	34	1.79	1.15	61
April 12[a]	G. B. Monk	52	58	3.09	1.70	179
May 5	T. E. Brick	58	117	3.01	2.10	352
May 26[b]	M. C. Hinderlider		161	3.50	2.90	563
June 28[c]	T. E. Brick	42	122	6.58	3.20	803
July 26[d]	R. I. Meeker	63	103	2.45	1.90	252
July 29[b]	T. Tobish		143	3.57	2.85	510
August 18[d]	T. E. Brick	56	177	6.18	4.35	1,094
September 8[c]	do	54	94	3.52	2.10	331
September 8[d]	do	76	134	2.58	2.10	343

[a] Wading one-fourth mile below station.
[b] North Fork and South Fork.
[c] From bridge at rod.
[d] Wading 800 feet below station.

Mean daily gage height, in feet, of South Platte River at South Platte, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.62	2.55	1.28	1.12	1.75	2.55	2.55	2.90	3.25	2.05	1.32	1.05
2	1.80	2.62	1.28	1.20	2.00	2.60	2.45	2.90	2.92	1.98	1.20	1.00
3	2.00	2.40	1.12	1.20	2.25	3.55	2.60	2.85	2.95	1.78	1.08	1.05
4	1.85	1.30	1.08	1.22	2.12	2.60	2.75	2.95	2.85	1.90	1.00	1.05
5	1.85	1.25	1.12	1.22	2.12	2.42	2.82	2.90	2.82	2.08	1.05	1.05
6	1.78	1.20	1.15	1.18	2.20	2.40	2.75	2.50	4.32	2.25	1.00	1.08
7	1.58	1.20	1.15	1.22	2.42	2.48	2.30	2.25	2.78	2.28	.98	1.10
8	1.45	1.28	1.12	1.25	2.40	2.72	2.40	2.20	2.08	2.35	1.00	1.10
9	1.40	1.38	1.10	1.38	2.38	2.70	2.75	2.20	2.15	2.40	1.02	1.20
10	1.52	1.25	1.15	1.88	2.30	2.52	3.40	2.12	2.18	2.32	1.05	1.22
11	1.60	1.22	1.42	1.50	2.38	2.45	2.95	2.40	2.32	2.40	1.00	1.15
12	1.45	1.40	1.25	1.75	2.45	3.05	2.35	2.60	2.40	2.32	1.10	1.25
13	1.55	1.35	1.00	1.75	2.70	3.25	2.30	2.85	2.40	2.15	1.00	(a)
14	1.45	1.40	1.00	1.90	3.00	3.05	2.15	3.40	2.28	2.00	.95	.....
15	1.40	1.35	1.02	1.75	2.98	3.22	2.10	3.90	2.12	2.00	1.02	.....
16	1.40	1.30	1.10	1.85	2.72	2.95	2.00	3.90	2.05	1.98	1.12	.....
17	1.42	1.28	1.02	1.98	2.48	3.00	1.90	3.75	2.00	2.02	1.10	.....
18	1.40	1.30	1.12	2.18	2.50	2.85	1.70	3.60	2.08	2.10	1.00	.....
19	1.30	1.25	1.15	2.12	2.55	3.12	1.70	4.35	1.98	2.08	1.02	.....
20	1.40	1.20	1.10	2.12	2.95	2.95	1.68	4.30	1.80	2.00	1.00	.....
21	1.40	1.12	1.20	1.90	2.68	2.88	1.70	3.80	1.62	1.92	1.10	.....
22	1.50	1.18	1.12	1.88	2.70	2.70	1.80	3.15	1.55	2.00	1.10	.....
23	1.28	1.12	1.10	1.92	3.48	2.62	1.75	2.90	1.60	2.08	1.00	.....
24	1.20	1.28	1.08	1.75	3.50	2.50	4.85	2.80	1.50	2.15	1.10	.....
25	1.18	1.22	1.00	1.62	3.25	2.60	2.50	2.80	1.60	2.18	1.15	.....
26	1.30	1.38	1.08	1.75	2.90	2.55	1.88	2.50	1.68	2.08	1.02	.....
27	1.40	1.42	1.12	1.85	2.72	2.50	2.35	2.60	1.80	2.00	1.05	.....
28	1.35	1.30	1.08	1.98	2.62	3.10	2.70	2.85	1.95	1.88	1.18	.....
29	1.30	1.25	1.12	2.15	2.50	3.50	2.70	3.60	2.02	1.65	1.20	.....
30	1.56	.....	1.10	1.90	2.58	3.05	2.45	3.80	2.10	1.55	1.12	.....
31	2.48	.....	1.18	.....	2.75	.....	2.65	3.60	.....	1.42	.....	.....

[a] River frozen during remainder of year.

Rating table for South Platte River at South Platte, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	20	2.00	287	3.00	600	4.00	958
1.00	37	2.10	317	3.10	634	4.10	997
1.10	54	2.20	347	3.20	668	4.20	1,037
1.20	75	2.30	377	3.30	702	4.30	1,077
1.30	98	2.40	407	3.40	738	4.40	1,117
1.40	121	2.50	438	3.50	774	4.50	1,157
1.50	147	2.60	470	3.60	810	4.60	1,198
1.60	173	2.70	502	3.70	846	4.70	1,240
1.70	200	2.80	534	3.80	883	4.80	1,284
1.80	228	2.90	567	3.90	920	4.90	1,330
1.90	257						

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of South Platte River at South Platte, Colo., for 1904.

[Drainage area, 2,612 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	432	71	155	9,531	0.059	0.068
February	476	58	129	7,420	.049	.053
March	126	37	60.4	3,714	.023	.027
April	341	58	196	11,660	.075	.084
May	685	214	470	28,900	.180	.208
June	792	407	541	32,190	.207	.231
July	1,307	195	421	25,890	.161	.186
August	1,097	323	633	38,920	.242	.279
September	1,085	147	366	21,780	.140	.156
October	407	126	301	18,510	.115	.133
November	103	28	49.3	2,934	.019	.021
December 1-12	86	37	56.7	1,350	.022	.0098
The period	1,307	28	.....	202,800	.....	.....

SOUTH PLATTE RIVER AT DENVER, COLO.

In the spring of 1895 a river station was established at the Twenty-third Street Viaduct in the city of Denver, but observations were discontinued on June 18, as the location was found to be unfavorable for accurate measurements, and the water had fallen below the gage. In July a station was established at the Fifteenth Street Bridge and observations were begun, these being made in the morning and in the afternoon. Stream measurements were then made from the lower side of the bridge. The original gage consisted of two 6 by 2 inch timbers spiked together, inclined and graduated to vertical tenths of a foot. The space between the marks was 0.156 foot. The timbers were fastened to posts driven into the bank. The bench mark is 107 feet southwest from the gage and is a cross mark on top of the east abutment of the Fifteenth Street Bridge on the north corner. It is marked "B. M." and is 6.15 feet above the 9-foot mark of the original Fifteenth street gage rod, which has since been destroyed.

Another inclined gage rod, reading the same as the one on the right bank, was placed on the left side in August, 1898. It consisted of a 4 by 4 inch timber 12 feet long fastened to posts driven into the left bank and graduated to vertical feet and tenths.

This rod was washed out by the high water of June, 1900, which also removed the sand bar in front of the rod on the right-hand side, making it available at low-water stages, and since that time the readings have been taken from the latter rod, or from rods which replaced it and which were located at the same point.

May 15, 1901, a T-rail was placed on the site of the latter rod, which was stolen. The rail was embedded in an inclined position in the slag bank. All readings were taken from this rod from May 15, 1901, to June 9, 1903, when the rod was again stolen. On June 10, 1903, a vertical 4 by 4 inch timber was placed at the same point and fastened to a cottonwood tree. The zero of the rod was placed at the same elevation as the zero of the old gage. It is read twice each day by Clarence Crisman.

The present gage and the bridge from which measurements are made are located at a point immediately below the mouth of Cherry Creek, which enters between the Fourteenth and Fifteenth Street bridges. The stream at this point is confined between artificial embankments of furnace slag.

Discharge measurements are made by wading at a point below or above the gage at low water and from the Fifteenth Street Bridge at high water. The initial point for soundings is the edge of the right abutment of the Fifteenth Street Bridge. The channel is straight for 100 feet above and for 500 feet below the station. The current is swift at high stages, but becomes sluggish at low stages. The banks

are slag embankments and can only overflow at extreme flood stages. The bed is composed of sand, free from vegetation, but very shifting. The bench mark is the top of the capstone on the south end of the southeast abutment of the Sixteenth Street Viaduct on the right bank below the gage. Its elevation is 12.00 feet above the zero of the gage.

This station is important principally from the fact that it is used as a training station for instructing young hydrographers in the Denver office in the use of the current meter in field practice.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of South Platte River at Denver, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 18	M. C. Hinderlider	26	35	2.09	0.73	73
February 3	T. E. Brick	49	48	1.50	.70	72
February 3	do	26	34	2.09	.70	71
February 15	do	26	35	1.94	.68	68
February 15	do	26	35	2.11	.72	74
February 27	G. B. Monk	24	33	2.33	.78	78
February 27	M. P. Beeson	24	33	2.33	.77	77
March 19	G. E. Moore	22	33	1.73	.70	57
March 19	T. E. Brick	22	33	1.70	.70	56
April 9	G. B. Monk	25	32	1.41	.70	45
April 20	do	28	39	2.38	1.00	93
May 5	M. P. Beeson	61	109	2.50	1.60	270
May 5	do	60	108	2.51	1.60	271
May 13	T. E. Brick	62	135	2.83	1.90	382
June 3	do	196	406	4.19	3.45	1,701
June 4	T. Tobish	181	322	4.11	2.98	1,325
June 20	M. P. Beeson	71	140	3.09	1.75	433
June 20	do	71	141	3.09	1.78	436
June 25	do	71	105	2.43	1.45	255
June 29	do	88	166	3.87	2.38	643
July 6	G. B. Monk	85	186	3.15	2.20	585
July 25	R. I. Meeker	92	178	3.58	2.45	637
July 29	M. P. Beeson	88	148	3.61	2.25	535
August 15	T. E. Brick	95	167	4.17	2.50	697
September 1	M. P. Beeson	85	123	3.12	1.92	384
September 1	do	85	126	2.92	1.85	368
October 27	G. E. Moore	34	36	3.61	1.00	130
November 19	M. P. Beeson	68	75	1.96	1.20	147

NOTE.—The area and mean velocities are not comparable as measurements were made at different sections.

Mean daily discharge [a], in second-feet, of South Platte River at Denver, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	76	68	92	59	195	505	416	384	398	407	108	132
2	80	72	82	58	287	252	328	398	335	309	104	132
3	82	70	89	47	376	1,000	305	384	384	309	102	128
4	76	72	81	59	320	1,170	625	597	335	198	108	109
5	70	68	80	58	298	520	566	305	412	117	139	111
6	61	68	66	53	242	407	625	324	384	147	120	102
7	72	68	76	45	159	273	475	324	343	118	109	102
8	70	64	75	52	430	291	398	305	235	139	108	111
9	72	72	68	54	287	500	242	235	235	164	120	104
10	76	64	57	51	242	625	168	192	235	176	145	109
11	70	64	66	47	287	490	324	220	154	154	122	82
12	68	76	69	49	363	657	320	220	206	132	113	80
13	70	80	49	59	262	705	316	269	143	122	104	80
14	76	80	70	62	324	604	269	407	113	104	139	80
15	82	72	50	61	560	604	287	705	99	96	186	70
16	82	64	45	64	455	536	220	900	96	106	171	64
17	92	68	48	69	351	455	186	750	82	104	145	89
18	72	68	50	178	252	465	171	625	154	104	124	89
19	82	68	57	88	313	460	83	586	113	122	108	80
20	76	72	56	99	363	440	161	510	93	117	139	85
21	72	70	54	109	407	470	242	450	117	126	122	82
22	70	68	59	134	455	430	128	328	154	113	106	72
23	51	68	63	93	455	393	198	309	262	150	102	85
24	61	82	55	95	560	269	566	278	269	164	106	98
25	68	76	62	102	490	287	800	355	305	164	106	82
26	70	85	59	117	343	269	578	313	287	159	117	82
27	64	61	56	186	750	324	355	276	276	136	126	72
28	61	85	60	145	324	214	320	294	276	130	130	235
29	61	93	54	139	212	440	455	520	269	126	130	113
30	61	.....	59	192	287	413	363	510	252	124	139	99
31	68	.....	59	.....	430	.....	384	470	.....	108	.....	89

[a] Daily discharges obtained indirectly, according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

Estimated monthly discharge of South Platte River at Denver, Colo., for 1904.

[Drainage area, 3,840 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	82	51	71.0	4,366	0.018	0.021
February	93	61	71.9	4,136	.019	.020
March	92	45	63.4	3,898	.017	.020
April	192	45	87.5	5,207	.023	.026
May	750	159	357	21,950	.093	.107
June	1,170	214	482	28,680	.126	.141
July	800	83	351	21,580	.091	.105
August	900	192	409	25,150	.107	.123
September	412	82	234	13,920	.061	.068
October	407	96	153	9,408	.040	.046
November	186	102	123	7,319	.032	.036
December	235	64	98.2	6,038	.026	.030
The year	1,170	45	209	151,700	.054	.743

SOUTH PLATTE RIVER NEAR JULESBURG, COLO.

This station was established April 2, 1902, by John E. Field, at the wagon bridge crossing South Platte River, about 1 mile southeast of Julesburg, Colo., a station at the junction of the main line and Denver Branch of the Union Pacific Railroad. As this is the last station on South Platte River in Colorado, and is also below all irrigation ditches in Colorado taking water from the South Platte, with the exception of one, it is of considerable importance for securing data relative to the flow of return waters as well as the natural flow in the main channel. However, the conditions at this station are not as desirable as they should be, owing to the great width of the channel and the general instability of the bed of the stream, features characteristic of the whole course of South Platte River through this part of the State. The channel at this point is about one-half mile wide, and at low stages of the river it is badly broken up by islands, causing the stream to flow in several different channels. The banks are low, but do not overflow. The bed of the river is dry during the greater part of the year. The gage heights from March 15 to March 31, and from November 25 to December 31, 1903, were affected by ice gorges and anchor ice, so that no rating table could be constructed for those periods. The gage is a 2 by 4 inch vertical timber spiked to a pile of the bridge about 600 feet from the north end. It is read once each day by T. W. Jenkins.

Discharge measurements are made at high water from the bridge, which is one-half mile long and is supported on piles at intervals of 20 feet. The initial point for soundings is the north abutment on the left bank. The channel is straight for 600 feet above and 400 feet below the station. The right bank is low, but is not liable to overflow. The left bank overflows only at very high stages. The section is broad and shallow, with a sandy, changeable bed. The channel is broken by islands at ordinary stages, and is covered with undergrowth and vegetation. At low water it is impossible to measure the velocity in the many small channels and the discharge has to be estimated. The bench mark is a 20-penny nail driven into the south face of the cap on the piling to which the gage is spiked. It is directly over the gage rod and is inclosed in a circle of white paint and marked "B. M." Its elevation is 8.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of South Platte River near Julesburg, Colo., in 1904.

Date.	Hydrographer.	Mean velocity.	Discharge.
		Ft. per sec.	*Second-feet.*
March 8	M. C. Hinderlider	1.35	88
March 16	T. W. Jenkins	1.18	19
March 26	do	1.18	23
April 2	do	1.17	15
April 9	do	1.18	16
April 16	do	1.10	12
April 30	do	1.42	65
May 9	do	2.02	546
May 27	do	1.76	228
June 3	do	2.60	1,542
June 7	do	2.98	2,988

Mean daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.90	1.15	1.40	2.00	2.10	1.30	1.30	1.60	1.40	1.65
2	1.75	1.15	1.30	2.61	1.85	1.30	1.30	1.60	1.35	1.65
3	1.65	1.15	1.30	2.50	1.85	2.15	1.25	1.55	1.35	1.60
4	1.55	1.15	1.30	2.20	1.75	1.40	1.25	1.50	1.30	1.60
5	1.60	1.20	1.40	2.00	1.65	1.35	1.20	1.50	1.30	1.75
6	1.60	1.20	1.40	3.15	1.60	1.35	1.20	1.45	1.30	1.80
7	1.45	1.20	1.35	3.00	1.85	1.35	1.20	1.45	1.30	1.75
8	1.35	1.20	1.35	3.20	1.80	1.30	1.20	1.65	1.30	1.85
9	1.35	1.20	2.00	3.00	1.70	1.30	1.20	1.60	1.30	1.85
10	1.30	1.20	1.80	2.90	1.60	1.30	1.20	1.55	1.30	1.85
11	1.25	1.20	1.70	2.65	1.60	1.25	1.20	1.55	1.30	1.85
12	1.20	1.15	1.60	2.55	1.95	1.25	1.20	1.50	1.30	1.85
13	1.20	1.15	1.45	2.50	1.90	1.25	1.20	1.40	1.30	1.85
14	1.20	1.15	1.40	2.75	1.80	1.25	1.20	1.40	1.35	1.90
15	1.20	1.00	1.35	2.80	1.60	1.25	1.15	1.35	1.40	1.90
16	1.20	1.00	1.35	2.70	1.55	1.20	1.15	1.30	1.65	(a)
17	1.20	1.00	1.30	2.70	1.50	1.20	1.15	1.30	1.60	.....
18	1.20	1.00	1.30	2.70	1.45	1.35	1.15	1.40	1.55	.....
19	1.20	1.00	1.30	2.70	1.45	1.30	1.15	1.45	1.55	.....
20	1.20	1.15	1.30	2.65	1.60	1.25	1.15	1.40	1.55	.....
21	1.20	1.20	1.30	2.60	1.60	1.25	1.15	1.35	1.55	.....
22	1.20	1.20	1.30	2.55	1.60	1.25	1.15	1.30	1.60	.....
23	1.20	1.20	1.30	2.50	1.60	1.20	1.15	1.30	1.60	.....
24	1.20	1.20	1.30	2.45	1.60	1.20	1.15	1.30	1.65	.....
25	1.20	1.25	1.20	2.40	1.60	1.20	1.15	1.30	1.80	.....
26	1.20	1.20	1.30	2.40	1.55	1.20	1.15	1.30	1.80	.....
27	1.20	1.15	1.75	2.35	1.50	1.20	1.15	1.30	1.80	.....
28	1.20	1.00	1.60	2.30	1.50	1.20	1.15	1.35	1.75	.....
29	1.20	1.20	1.60	2.25	1.45	1.20	1.15	1.55	1.75	.....
30	1.15	1.45	1.65	2.20	1.35	1.20	1.65	1.50	1.70	.....
31	1.15	.....	1.80	.....	1.30	1.20	.....	1.45	.....	.....

(a) Frozen during remainder of year.

Rating table for South Platte River near Julesburg, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	4	1.45	75	1.85	315	2.50	1,315
1.05	7	1.50	95	1.90	360	2.60	1,550
1.10	10	1.55	115	1.95	410	2.70	1,830
1.15	15	1.60	140	2.00	465	2.80	2,200
1.20	20	1.65	165	2.10	590	2.90	2,620
1.25	25	1.70	195	2.20	735	3.00	3,060
1.30	35	1.75	230	2.30	905	3.10	3,530
1.35	45	1.80	270	2.40	1,100	3.20	4,040
1.40	60						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1 foot and 3 feet.

Estimated monthly discharge of South Platte River near Julesburg, Colo., for 1904.

[Drainage area, 20,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	360	15	56.9	3,499	0.0028	0.0032
April	75	4	17.3	1,029	.00084	.00094
May	465	35	95.6	5,878	.0046	.0053
June	4,040	465	1,663	98,960	.081	.090
July	590	35	182	11,190	.0088	.010
August	660	20	49.4	3,038	.0024	.0028
September	165	15	23.7	1,410	.0012	.0013
October	165	35	76.8	4,722	.0037	.0043
November	270	35	109	6,486	.0053	.0059
December 1–15	360	140	263	7,824	.013	.0072
The period				144,000		

CLEAR CREEK AT FORKSCREEK, COLO.

This station was originaly established May 29, 1899, by John E. Field. The station is located at the United States Geological Survey footbridge just below the Colorado and Southern Railroad bridge near the railroad station, and is an important station on account of its location above all diversions on this stream, which is entirely used for power and irrigation purposes. The chain gage is fastened to the wooden cribwork on the left bank 30 feet below the footbridge. The length of the chain from the end of the weight to the marker is 20.25 feet. Discharge measurements are made from the single-span footbridge. The initial point for soundings is a brass-headed nail on the rail of the bridge at the north end. It is marked zero with white paint. The channel is straight for 30 feet above and 150 feet below the station. Both banks are high and are not liable to overflow. The right bank is the side of the mountain and the left bank is the retaining wall of the railroad embankment. The bed of the stream is composed of small cobblestones and bowlders, with some silt at low stages. The current is rapid and it is necessary to use a stay wire on the meter at high stages. The bench mark, established October 8, 1903, is a cross cut in the top of the downstream stringer over the first strut from the south end of the footbridge. When established its elevation above the gage datum was 14.73 feet. The gage is read twice each day by C. W. Hoisington.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 19[a]	R. I. Meeker					43
April 14	G. B. Monk	30	33	3.42	2.00	113
May 4	T. E. Brick	30	41	5.17	2.52	212
May 24	do	36	104	10.75	3.85	1,118
July 26	do	34	70	7.23	3.35	506
August 16	do	34	65	5.80	3.10	377
September 20	G. B. Monk	30	54	4.17	2.60	225
September 20	M. P. Beeson	30	54	4.35	2.60	235

[a] North and South forks.

Mean daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.90	2.52	3.80	3.85	3.35	3.22	2.78
2	1.90	2.72	3.80	3.80	3.15	3.18	2.78
3	1.92	2.70	3.72	3.70	3.08	3.18	2.75
4	1.90	2.55	3.55	3.70	3.08	3.12	2.72
5	1.92	2.52	3.45	3.70	3.08	3.10	2.65
6	1.90	2.62	3.42	3.68	3.02	3.02	2.65
7	1.82	2.72	3.55	3.68	3.00	3.00	2.65
8	1.85	2.70	3.72	3.62	3.02	3.00	2.70
9	1.75	2.70	3.75	3.65	2.92	2.98	2.68
10	1.88	2.68	3.65	3.62	2.90	2.92	2.65
11	2.02	2.72	3.75	3.65	2.90	2.98	2.65
12	2.12	2.88	3.90	3.65	3.12	2.90	2.60
13	2.18	2.88	4.15	3.58	3.10	2.85	2.60
14	2.22	2.98	4.15	3.55	3.20	2.85	2.60
15	2.22	2.95	4.05	3.48	3.20	2.85	2.60
16	2.08	2.90	4.22	3.45	3.10	3.02	2.60
17	2.18	2.88	4.20	3.45	3.10	2.90	2.60
18	2.22	3.00	4.22	3.45	3.35	2.82	2.60
19	2.32	3.08	4.25	3.38	3.20	2.80	2.60
20	2.40	3.22	4.32	3.35	3.18	2.80	2.70
21	2.50	3.22	4.20	3.35	3.20	2.80	2.65
22	2.32	3.28	4.15	3.40	3.18	2.80	2.60
23	2.28	3.52	4.05	3.30	3.05	2.80	2.55
24	2.28	3.95	4.00	3.42	3.00	2.78	2.50
25	2.35	3.95	3.95	3.45	3.00	2.70	2.55
26	2.35	3.72	3.85	3.35	3.12	2.70	2.50
27	2.42	3.60	3.85	3.30	3.22	2.70	2.50
28	2.52	3.58	3.82	3.40	3.12	2.72	2.50
29	2.55	3.50	3.85	3.28	3.10	2.82	2.50
30	2.50	3.72	3.88	3.28	3.10	2.82	2.50
31		3.85		3.18	3.18		2.50

Rating table for Clear Creek at Forkscreek, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	92	2.20	139	3.00	340	3.70	820
1.75	95	2.30	155	3.10	380	3.80	935
1.80	98	2.40	173	3.20	430	3.90	1,060
1.85	101	2.50	192	3.30	485	4.00	1,190
1.90	105	2.60	216	3.40	550	4.10	1,330
1.95	109	2.70	240	3.50	625	4.20	1,470
2.00	113	2.80	268	3.60	720	4.30	1,610
2.10	125	2.90	300				

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly well defined between gage heights 2 feet and 3.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Clear Creek at Forkscreek, Colo., for 1904.

[Drainage area, 345 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	204	99	139	8,271	0.403	0.450
May	1,125	197	453	27,850	1.31	1.51
June	1,638	564	1,092	64,980	3.17	3.54
July	995	420	651	40,030	1.89	2.18
August	515	300	385	23,670	1.12	1.29
September	440	240	308	18,330	.893	.996
October	262	192	219	13,470	.635	.732
The period				196,600		

LOUP RIVER AT COLUMBUS, NEBR.

Observations at this station were begun October 13, 1894. The station was established by O. V. P. Stout. It is located about 75 yards above the Union Pacific Railroad bridge and about 6 miles above the mouth of the river. There is an island about 1,000 feet above the gaging section. Discharge measurements are made by means of a five-eighths inch cable and car. The cable is fastened to a large tree, and is supported by a post on the west bank. On the east bank it is anchored to a timber set in the ground. Distances from the initial point are marked in red paint on the cable at 12½-foot intervals. The initial

point for soundings is the zero mark on the cable. The channel is straight for 1,000 feet above and 300 feet below the cable. At a point 150 feet below the cable the current is broken by old piling and masonry piers of a railroad bridge. The section at the gage is broad and shallow, with rapid velocity and a shifting, sandy bed. The right bank is low, sandy, covered with willows and brush, and is liable to overflow at very high stages. The left bank is about 10 feet high and is not liable to overflow. Two gages are maintained at this station since in times of high flood or ice gorges the upper one often becomes inaccessible.

The upper gage is a vertical rod 12 feet long bolted to piling 160 feet above the railroad bridge on the left bank.

The lower gage is of the regulation chain and weight type and was installed June 24, 1904, at the highway bridge south of Columbus about 1½ miles below the upper gage at the Union Pacific Railroad bridge. The distance from the end of the weight to the index is 24.50 feet.

Bench mark No. 1 is a standard 4-foot iron post of the Geological Survey, located 72 feet east of the upper gage. Its elevation is 21.83 feet above the zero of the lower gage and 13.27 feet above the zero of the upper gage. On account of the constantly changing cross section a large number of discharge measurements are necessary to obtain the daily discharge with a fair degree of accuracy. In order to render the readings of the two gages comparable the fall of the river was very carefully determined between the two and found to be 8.56 feet. The lower gage was then set to read the same as the upper gage; that is, a difference of 8.56 feet exists between the zeros of the two gages, but the bench marks are referred to the same datum; that is, to the zero of the lower gage. Bench mark No. 2 was also established on the above date at the lower gage and is a cross cut on the west end of the cap of the first bent of the north bridge approach. Its elevation above gage datum is 10.91 feet.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Loup River at Columbus, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 25	J. C. Stevens	525	961	3.23	4.75	3,099
May 8	do	.....	1,293	2.69	5.31	3,483
June 18	do	520	1,065	3.24	4.85	3,442
June 25	do	506	1,682	2.75	5.46	4,630
July 29	do	514	1,130	2.57	4.82	2,898
July 29	do	516	1,274	2.64	4.82	3,376
July 31	do	512	1,084	2.52	4.77	2,737
July 31	do	515	1,036	2.63	4.77	2,723
July 31	do	515	1,067	2.60	4.77	2,778
July 31	do	515	1,045	2.61	4.80	2,734
July 31	do	515	1,020	2.44	4.80	2,492
July 31	do	515	1,018	2.78	4.80	2,826
September 2	do	.....	1,036	2.78	5.01	2,880

Mean daily gage height, in feet, of Loup River at Columbus, Nebr., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.95	4.95	4.70	4.90	4.52	4.90	5.10	4.45
2	.....	4.90	4.90	4.80	4.90	4.48	5.00	5.35	4.45
3	.....	4.92	4.90	5.10	4.90	4.71	5.60	5.30	4.40
4	.....	4.90	4.95	5.15	4.95	4.84	5.20	5.25	4.45
5	.....	4.90	4.95	5.20	5.00	4.87	5.00	5.10	4.45
6	.....	4.95	4.98	5.15	5.78	4.85	4.65	4.85	4.30
7	.....	5.00	.....	4.95	6.00	4.80	4.65	4.65	4.45
8	.....	5.20	5.30	4.95	6.25	4.85	4.65	4.65	4.55
9	.....	5.10	5.30	5.10	5.80	5.15	4.56	4.70	4.55
10	.....	5.05	5.25	7.30	6.49	5.15	4.48	4.95	4.60
11	.....	5.00	5.20	5.60	6.20	4.75	4.40	4.85	4.60
12	.....	5.00	5.15	5.40	5.42	4.65	4.50	5.00	4.60
13	5.35	4.95	5.15	5.30	4.96	4.55	4.50	4.90	4.60
14	5.35	4.90	5.15	5.80	4.82	4.50	4.50	4.80	4.55
15	5.30	4.90	5.15	5.40	4.72	4.42	5.10	4.80	4.60
16	5.10	4.90	5.05	5.20	4.60	4.45	4.60	4.75	4.60
17	5.00	4.90	5.00	5.00	4.75	4.50	4.55	4.70	4.60
18	4.95	4.95	5.00	4.85	6.30	4.60	4.45	5.10	4.65
19	4.90	4.95	5.00	4.90	5.11	4.72	4.55	6.30	4.60
20	4.85	5.00	5.00	4.80	5.10	4.77	4.50	6.10	4.69
21	4.80	5.05	5.00	4.90	5.10	4.85	4.60	5.00	4.65
22	4.80	5.05	5.00	4.75	5.80	4.65	4.70	4.80	4.65
23	4.80	5.10	4.98	4.60	4.80	4.45	4.70	4.80	4.65
24	4.80	5.15	5.00	4.75	4.70	4.40	4.60	4.55	4.80
25	4.75	5.40	.....	5.42	4.70	4.40	4.70	4.50	4.50
26	4.75	5.35	5.90	5.45	4.75	4.40	4.70	4.40	4.50
27	4.75	5.20	5.00	5.30	4.70	4.40	4.70	4.45	.....
28	4.80	5.05	4.90	5.10	4.95	4.40	4.90	4.40	.....
29	4.80	4.98	4.50	5.00	4.70	4.40	5.00	4.45	.....
30	4.89	4.95	4.50	4.92	4.64	4.45	5.00	4.50	.....
31	4.95	.....	4.50	.....	4.56	5.10	.....	4.45	.....

Mean daily discharge, in second-feet, of Loup River at Columbus, Nebr., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3,550	2,740	2,500	2,740	2,150	2,740	3,260	1,740
2	.....	3,400	2,500	2,740	2,740	2,150	2,870	4,090	1,740
3	.....	3,400	2,500	3,710	2,740	2,620	4,960	3,890	1,660
4	.....	3,260	2,620	3,890	2,870	3,000	3,400	3,710	1,740
5	.....	3,260	2,500	4,090	3,000	3,000	3,000	3,260	1,740
6	.....	3,400	2,620	3,890	6,060	3,000	2,150	2,620	1,510
7	.....	3,550	3,000	3,400	7,050	2,870	2,150	2,150	1,740
8	.....	4,300	3,400	3,400	9,250	3,000	2,150	2,150	1,930
9	.....	3,710	3,400	3,890	6,060	3,890	1,930	2,260	1,930
10	.....	3,550	3,260	20,000	11,750	3,710	1,820	2,870	2,040
11	.....	3,400	3,130	6,060	9,250	2,620	1,660	2,620	2,040
12	.....	3,400	3,130	5,400	4,520	2,380	1,820	3,000	2,040
13	5,400	3,260	3,130	4,960	3,000	2,150	1,820	2,740	2,040
14	5,400	3,000	3,130	7,400	2,620	2,040	1,820	2,500	1,930
15	5,180	3,000	3,130	5,400	2,380	1,820	3,260	2,500	2,040
16	4,300	3,000	3,000	4,520	2,150	1,820	2,040	2,380	2,040
17	3,890	3,000	2,870	3,890	2,380	1,930	1,930	2,260	2,040
18	3,710	3,000	2,870	3,400	10,250	2,150	1,740	3,260	2,150
19	3,550	3,000	2,870	3,400	3,550	2,380	1,930	9,750	2,040
20	3,400	3,130	3,000	3,000	3,550	2,500	1,820	7,800	2,260
21	3,260	3,260	3,000	3,130	3,550	2,740	2,040	3,000	2,150
22	3,260	3,260	3,000	2,620	6,500	2,150	2,260	2,500	2,150
23	3,260	3,260	3,000	2,150	2,740	1,740	2,760	2,500	2,150
24	3,260	3,400	3,000	2,380	2,500	2,660	2,040	1,930	2,500
25	3,130	4,300	4,750	4,300	2,500	1,660	2,260	1,820	1,820
26	3,130	4,090	6,500	4,520	2,740	1,660	2,260	1,660	1,820
27	3,130	3,550	3,130	3,890	2,620	1,660	2,260	1,740	.....
28	3,260	3,000	2,870	3,260	3,260	1,660	2,740	1,660	.....
29	3,260	2,870	1,930	3,000	2,620	1,660	3,000	1,740	.....
30	3,260	2,740	1,930	2,740	2,500	1,740	3,130	1,820	.....
31	3,550	.....	2,040	.....	2,820	3,260	.....	1,740	.....

NOTE.—Daily discharge obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

Estimated monthly discharge of Loup River at Columbus, Nebr., for 1904.

[Drainage area, 13,540 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 13–31	5,400	3,130	3,715	140,000	0.274	0.194
April	4,300	2,740	3,343	198,900	.247	.276
May	6,500	1,930	3,031	186,400	.224	.258
June	20,000	2,150	4,364	259,700	.322	.359
July	11,750	2,150	4,266	262,300	.315	.363
August	3,890	1,660	2,380	146,300	.176	.203
September	4,960	1,660	2,392	142,300	.177	.198
October	9,750	1,660	2,941	180,800	.217	.250
November 1–26	2,500	1,510	1,961	101,100	.145	.140
The period				1,618,000		

NOTE.—The measurements made in 1904 were not sufficiently well distributed to make the above monthly estimate other than a rough approximation.

MISCELLANEOUS MEASUREMENTS IN THE PLATTE RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Platte River drainage basin in Nebraska, in 1904:

Miscellaneous measurements in the Platte River drainage basin in 1904.

Date.	Hydrographer.	Stream.	Locality.	Area.	Mean velocity.	Discharge.
				Sq. feet.	*Ft. per sec.*	*Sec.-feet*
August 31	H. O. Smith	Blue Creek	Sec. 18, T. 16, R. 42			48
June 22	R. D. Hubbard	Calf Creek	Sec. 5, T. 25, R. 26			1
September 15	do	Dismal River	Dunning, Nebr.			395
May 26	J. C. Stevens	Elkhorn River	Arlington, Nebr	523	2.57	1,343
May 26	do	do	do	526	2.44	1,284
September 13	R. D. Hubbard	Goose Creek	Sec. 18, T. 25, R. 24			14.4
June 10	R. H. Willis	Glenwood Creek	Sec. 15, T. 18, R. 50			6
April 27	H. O. Smith	Lodgepole River	Sec. 8, T. 14, R. 51			8.6
April 27	do	do	Sec. 9, T. 14, R. 51			7.6
April 27	do	do	Sec. 10, T. 14, R. 51			7.2
April 28	do	do	Sec. 33, T. 15, R. 56			14.4
April 30	do	do	Sec. 31, T. 15, R. 56			12.4
May 2	do	do	State line, Colo.-Nebr.			4.3
May 2	do	do	1 mi. E. State line			4.6
May 3	do	do	Sec. 8, T. 14, R. 58			34.7
May 4	do	do	Sec. 29, T. 15, R. 55			20.5
May 5	do	do	Sec. 33, T. 15, R. 56			48.2
June 15	do	do	Kimball, Nebr.			2.1

Miscellaneous measurements in the Platte River drainage basin in 1904—Continued.

Date.	Hydrographer.	Stream.	Locality.	Area.	Mean velocity.	Discharge.
				Sq. feet.	*Ft. per sec.*	*Sec.-feet.*
September 6	H. O. Smith	Lodgepole River	Kimball, Nebr.			13.4
September 8	do	do	3 mi. W. Kimball, Nebr.			8.7
September 8	do	do	Sec. 31, T. 14, R. 46			3.3
May 24	R. D. Hubbard	Middle Loup River.	Seneca, Nebr.	82	2.50	205
May 24	do	do	Thedford, Nebr	92	2.95	271
June 10	do	do	Arcadia, Nebr.	365	3.40	2,162
June 10	do	do	St. Paul, Nebr.	2,079	6.16	a12,800
June 22	J. A. Green	do	Thedford, Nebr	90	2.58	232
October 11	Adna Dobson	do	Sec. 32, T. 19, R. 21, Nebr.			878
June 10	R. D. Hubbard	North Loup River	St. Paul, Nebr	827	2.68	2,219
June 20	do	do	Brownlee, Nebr	55	2.67	147
June 20	do	do	do	57	2.81	160
June 21	J. A. Green	do	Cascade, Nebr.	89	2.55	227
September 14	R. D. Hubbard	do	Brewster, Nebr.			467
July 26	J. A. Green	South Loup River	Callaway, Nebr			82
July 27	do	do	Sec. 27, T. 18, R. 26			9
July 28	do	do	Sec. 31, T. 17, R. 24			56
July 28	do	do	Sec. 30, T. 15, R. 21			103
July 25	do	Mud Creek	Litchfield, Nebr			37
May 7	J. C. Stevens	Platte River	Valley, Nebr	1,580	2.51	3,976
August 28	R. D. Hubbard	do	Grand Island, Nebr.			Dry.
September 13	H. O. Smith	do	Sec. 29, T. 12, R. 26			36
August 27	do	North Platte River	Southerland, Nebr.			27
August 28	do	do	Sec. 18, T. 14, R. 36			30
August 30	do	do	Lewellen, Nebr			60
March 26	J. C. Stevens	South Platte River	North Platte, Nebr			Dry.
April 17	Adna Dobson	do	Ogalalla, Nebr			Dry.
May 27	J. C. Stevens	do	Julesburg, Nebr			130
May 27	R. D. Hubbard	do	North Platte, Nebr.			11
June 13	J. C. Stevens	do	do	906	2.46	2,231
June 16	H. O. Smith	Pumpkin Seed Creek	Sec. 33, T. 19, R. 52			11.4
April 30	R. D. Hubbard	Spotted Tail Creek	Sec. 2, T. 23, R. 56			1
October 11	Adna Dobson	Victoria Creek	Sec. 1, T. 19, R. 21			2.6

a Flood measurement gage height 3.60.

KANSAS RIVER DRAINAGE BASIN.

The drainage basin of Kansas River lies between those of the Platte and Arkansas rivers, being entirely within the region of the Great Plains and principally within the arid or semiarid area. It has no mountain tributaries, but depends entirely for its water supply upon the water which, falling within or near the basin, percolates slowly to the drainage channels. The catchment area extends from eastern Colorado to Missouri River, a distance from east to west of 485 miles. Its extreme width is about 200 miles. The main stream of Kansas River is formed at Junction, Kans., by Republican and Smoky Hill

rivers and flows east into the Missouri at Kansas City. The Republican, its principal tributary, drains southern Nebraska and northern Kansas by means of many small tributary creeks. Solomon, Saline, and Smoky Hill rivers drain the plains of northwestern Kansas. Blue River is a tributary in northeastern Kansas, flowing south into Kansas River near Manhattan, Kans.

KANSAS RIVER NEAR ST. GEORGE, KANS.

This station was established as a flood station April 13, 1904, by M. C. Hinderlider. It is located at the highway bridge one-fourth mile east of St. George, and opposite the Union Pacific Railroad tracks. A plain, vertical gage is painted on the north face of the upstream tube of the first pier from the left end of the bridge. It is graduated to feet and tenths from 10 to 26 feet. During 1904 the gage was read once daily, or oftener during sudden changes in the stage of the river, by G. A. Parr, station agent for the Union Pacific Railroad. Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the foot of the north abutment on the downstream side. The current is straight for about half a mile above and below the station, and the current is medium to swift. Both banks overflow for some distance back from the main stream. The bed of the stream is composed principally of shale, with a sand deposit in places, and is permanent on the left side of the river, but unstable on the right or south side. Bench mark No. 1 is a United States Geological Survey standard bench-mark tablet set in the southwest corner of the north masonry abutment of the bridge, on the top surface of the bridge seat. Its elevation is 26.268 feet above the datum of the gage, and 993.39 feet above sea level. Bench mark No. 2 is a United States Coast and Geodetic Survey bench mark on the window sill of Johnston's store in St. George, Kans. Its elevation is 37.571 feet above the datum of the gage, and 1,004.69 feet above sea level. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Gage heights, in feet, of Kansas River near St. George, Kans., for 1904.

Date.	A. M.	G. H.	P. M.	G. H.	Date.	A. M.	G. H.	P. M.	G. H.
		Feet.		*Feet.*			*Feet.*		*Feet.*
April 25	.....	.....	6.30	10.1	June 26	10.00	17.6	7.00	17.3
April 26	6.30	12.6	3.00	14.3	June 27	7.00	16.2	.....	.....
	11.00	13.8	7.30	14.3	June 28	7.00	14.4	.....	.....
April 27	6.30	13.6	7.00	12.8	June 29	7.00	12.6	7.00	12.3
May 9	.....	.....	7.00	10.0	June 30	7.00	13.3	.....	.....
May 10	7.00	10.4	7.00	10.5		12.00	14.3	7.00	14.0
May 11	7.00	10.0	.....	.....	July 1	7.00	13.6	7.00	12.3
	7.00	10.0	3.00	13.8	July 2	7.00	11.6	.....	.....
May 29	10.30	12.1	6.00	14.3	July 4	.....	.....	7.00	10.0
	12.00	13.0	.....	.....	July 5	7.00	11.3	7.00	12.4
May 30	7.00	12.6	7.00	12.0		6.00	16.6	.....	.....
May 31	7.00	11.7	7.00	11.2	July 6	9.00	17.6	3.00	19.0
June 1	7.00	11.0	7.00	11.6		12.00	18.3	7.00	19.6
June 2	7.00	11.8	7.00	10.9		7.00	18.6	.....	.....
June 3	7.00	11.0	7.00	12.8	July 7	10.00	18.0	3.00	17.6
	12.00	12.0	.....	.....		12.00	17.6	7.00	17.9
June 4	7.00	11.7	7.00	13.0		7.00	17.8	.....	.....
June 5	7.00	13.4	7.00	13.0	July 8	10.00	17.6	3.00	17.3
	12.00	13.2	.....	.....		12.00	17.4	7.00	17.1
June 6	7.00	12.3	7.00	11.6		7.00	17.1	.....	.....
June 7	7.00	10.9	7.00	10.3	July 9	10.00	17.1	3.00	16.6
June 11	7.00	10.6	7.00	11.0		12.00	16.9	7.00	16.2
June 15	.....	.....	7.00	10.6		7.00	15.5	.....	.....
June 16	7.00	11.1	7.00	11.8	July 10	10.00	15.2	7.00	15.1
	12.00	11.8	.....	.....	July 11	7.00	15.0	7.00	15.0
June 17	7.00	11.6	7.00	10.8	July 12	7.00	14.7	7.00	14.8
June 24	.....	.....	7.00	10.0	July 13	7.00	15.0	7.00	14.7
	7.00	12.4	3.00	17.0	July 14	7.00	14.2	.....	.....
June 25	10.00	15.0	7.00	17.6	July 15	7.00	13.6	.....	.....
	12.00	16.0	.....	.....	July 16	7.00	12.0	.....	.....
June 26	7.00	17.6	3.00	17.5					

KANSAS RIVER AT CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD BRIDGE, TOPEKA, KANS.

This station was established as a flood station April 14, 1904, by M. C. Hinderlider. It is located at the Chicago, Rock Island and Pacific Railroad bridge, about 2,100 feet above the Melan Arch Bridge, and 4,500 feet above the Atchison, Topeka and Santa Fe Railway bridge at Topeka, Kans. A plain gage, graduated to feet and tenths, is painted on the south face of the first pier from the left end of the bridge. The gage reads from 5 to 23 feet, the 10-foot mark being about 5 feet above mean low water. During 1904 the gage was read once daily, or oftener during sudden changes in the stage of the river, by E. M. Mathers, station agent for the Chicago, Rock Island and Pacific Railroad. Discharge measurements are made from the downstream side of the five-span bridge to which the gage is attached. The initial point for soundings is the north face of the right abutment. The channel is straight for about 1 mile above and below the station. The current is moderate at ordinary and swift at high stages. The right bank

is a 15-foot bluff, having a slope of about 45°, and composed principally of loam lined with loose riprap of stone. The left bank is not as high as the right bank and below the station leads on to a gravel bar which extends out for about 500 feet. Both banks are subject to overflow. The bed of the stream is composed of sand and silt, but is fairly permanent. The water flows in one channel at all ordinary stages broken by four concrete piers, and at very high water spreads out over North and South Topeka for distances varying from one-fourth to 1 mile out from the river channel. Bench mark No. 1 is a cross on the southwest corner of the left abutment, and is marked "U. S. G. S. B. M., El. 883.822." Its elevation is 23.635 feet above the datum of the gage. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurement of Kansas River at Chicago, Rock Island and Pacific Railroad bridge, Topeka, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 6	M. C. Hinderlider	820	4,616	5.09	11.95	23,480

Mean daily gage height, in feet, of Kansas River at Chicago, Rock Island and Pacific Railroad bridge, Topeka, Kans., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	.....	8.18	10.65	13.20	6.40	17	.....	9.20	11.10	11.40	5.70
2	.....	7.35	11.60	11.70	6.40	18	.....	8.60	10.30	10.70	5.60
3	.....	6.85	12.20	10.30	6.20	19	.....	7.92	.....	9.70	5.70
4	.....	6.70	12.35	10.50	6.20	20	.....	7.55	.....	8.60	5.80
5	.....	6.70	12.75	10.50	6.10	21	.....	7.00	.....	8.00	.....
6	.....	6.60	12.35	17.30	6.00	22	.....	6.75	.....	9.80	5.80
7	.....	6.60	10.60	22.05	.....	23	.....	6.45	.....	8.40	6.00
8	.....	7.55	10.05	19.40	6.00	24	.....	10.20	6.30	.....	8.20	5.90
9	.....	7.90	9.25	18.60	6.00	25	.....	10.42	6.20	12.05	8.10	5.80
10	.....	9.15	10.00	17.20	6.00	26	.....	10.62	6.40	16.85	7.70	5.80
11	.....	9.25	.....	16.35	6.00	27	.....	13.22	7.05	15.70	7.40	5.80
12	.....	8.30	.....	14.00	5.80	28	.....	12.10	6.62	14.10	7.40	.....
13	.....	8.25	.....	13.75	5.70	29	.....	11.60	12.35	12.70	6.90	5.50
14	.....	8.28	.....	13.70	.....	30	.....	9.80	17.55	11.70	6.70	5.20
15	.....	7.70	.....	12.80	5.70	31	.....	.....	12.38	.....	.....	5.20
16	.....	8.60	.....	12.10	5.70							

KANSAS RIVER AT ATCHISON, TOPEKA AND SANTA FE RAILWAY BRIDGE, TOPEKA, KANS.

This station was established as a flood station April 14, 1904, by M. C. Hinderlider. It is located at the Atchison, Topeka and Santa Fe Railroad bridge, 2,300 feet below the Melan Arch Bridge, and

4,500 feet below the Chicago, Rock Island and Pacific Railroad bridge, at Topeka, Kans. A plain vertical gage is painted on the south side of the third pier from the right abutment. The gage is graduated to feet and tenths from 10 to 23 feet, the 23-foot mark being at the top of the capstone and the 10-foot mark being about 5 feet above mean low water. During 1904 it was intended to have the gage read once a day or oftener during sudden rises in the stage of the river, but the observer failed to do this. Discharge measurements are made from the downstream side of the six-span bridge to which the gage is attached. The bridge has a trestle approach on the left end 316 feet long. The initial point for soundings is on the northeast corner of the right abutment. The channel is straight for 1 mile above and 1,000 feet below the station and the current is swift. The right bank is high and rocky, but is subject to overflow. The left bank is low, leading out to a sand and gravel bar extending out for about 1,000 feet. This was covered during the flood of 1903 and 1904 to a depth of from 3 to 8 feet. The bed of the stream is composed of sand and deposits of silt, and is unstable. The bench mark is a United States Coast and Geodetic Survey bench mark, designated as "N" in the records of the Geodetic Survey. It is on the northeast corner of the capstone of the right abutment of the bridge. Its elevation is 26.708 feet above the zero of the gage and 883.98 feet above mean sea level. The station has been abandoned.

KANSAS RIVER[a] AT LECOMPTON, KANS.

The gaging station at Lecompton was established April 16, 1899, at the new wagon bridge. On June 24, 1900, a new gage was established, the old gage having been broken. Later, a pine board 1 inch by 6 inches by 10 feet long, graduated to feet and tenths, was spiked on top of the old gage, at the same elevation. November 5, 1904, a new gage was put in; this gage is in three sections. The first is a pine board graduated from zero to 3 feet and spiked to a pile 23 feet north of the initial point. The second section is painted on the downstream pier of the second set and graduated from 3 feet to 10 feet, and the third section is painted on the upstream pier of the first set and is graduated from 10 feet to 29.5 feet. On October 26, 1900, a bench mark was established on top of the bottom flange of the iron strut, connecting the two iron cylinders at the south end of the highway bridge over the river. The bench mark is at the west end of the strut, next to the cylinder. Its elevation is 12.19 feet above the zero of the gage. The observer is A. D. McAdow. The channel is somewhat curved at the bridge, and the bridge is slightly oblique to the direction of the current. The channel has a width of 800 feet, broken by four metal piers. The left bank is low and subject to overflow

[a] Also known as Kaw River.

during high water. The bed of the stream is sandy, with some rock, and changes slightly.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Kansas River at Lecompton, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 18	W. G. Russell	695	1,513	2.25	3.10	3,532
April 28	do	752	7,973	4.11	10.95	32,780
May 31	do	774	8,174	4.61	11.50	37,730
June 7	do	772	7,057	4.06	9.70	28,690
July 10	do	808	12,660	4.48	14.25	56,660
July 15	do	780	8,504	4.28	10.43	36,370
November 5	do	603	1,652	2.47	2.80	4,078

Mean daily gage height, in feet, of Kansas River at Lecompton, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.00	3.20	3.60	5.70	6.90	10.10	11.10	4.80	3.20	3.50	3.25	2.30
2	4.00	3.20	3.50	5.60	6.20	10.60	9.60	4.55	3.20	3.75	3.20	2.30
3	4.00	3.20	3.50	5.60	5.75	11.85	8.70	4.25	3.20	3.80	3.15	2.30
4	4.00	3.10	3.50	5.50	5.55	11.05	8.45	4.20	3.20	3.95	3.10	2.30
5	3.90	3.10	3.50	5.45	5.35	10.75	10.10	4.15	3.20	4.00	2.80	2.30
6	3.90	3.10	3.50	5.40	5.15	10.80	16.75	4.10	3.10	4.00	2.80	2.30
7	3.85	3.10	3.50	5.30	5.00	9.50	20.75	4.05	3.10	4.00	2.80	2.30
8	3.80	3.00	3.50	5.30	5.70	8.00	18.75	4.00	3.10	3.90	2.70	2.30
9	3.80	3.00	3.40	5.20	6.20	8.10	16.45	4.00	3.05	3.90	2.70	2.20
10	3.75	3.00	3.40	5.20	6.35	7.70	14.55	3.90	3.00	3.90	2.70	2.20
11	3.70	3.00	3.40	5.15	6.70	7.80	13.15	3.85	3.00	3.90	2.65	2.20
12	3.70	3.00	3.40	5.10	7.00	7.95	12.10	3.80	3.00	3.90	2.60	2.20
13	3.60	3.00	3.40	5.00	7.00	7.75	11.40	3.80	3.00	3.80	2.60	2.20
14	3.60	3.00	3.30	5.00	6.80	7.25	11.00	3.80	3.00	3.80	2.60	2.20
15	3.60	3.00	3.20	4.95	6.95	6.90	10.50	3.80	3.00	3.80	2.60	2.20
16	3.50	3.05	3.15	4.90	7.75	7.35	9.55	3.70	3.00	3.80	2.60	2.20
17	3.50	3.10	3.00	4.90	8.25	9.10	8.95	3.70	3.00	3.80	2.50	2.10
18	3.50	3.20	3.10	4.90	7.60	8.60	8.65	3.70	3.00	3.80	2.50	2.10
19	3.50	3.30	3.10	4.80	7.55	7.75	7.10	3.65	2.95	3.75	2.50	2.10
20	3.50	3.30	3.10	4.75	7.50	7.20	6.75	3.60	2.90	3.70	2.50	2.10
21	3.45	3.40	3.10	4.75	7.30	7.00	6.65	3.60	2.90	3.70	2.50	2.10
22	3.40	3.40	3.20	4.85	7.05	6.70	7.25	3.55	2.90	3.70	2.50	2.00
23	3.40	3.50	3.30	5.00	6.70	6.20	7.35	3.50	2.90	3.60	2.45	2.00
24	3.40	3.50	3.90	8.00	6.30	6.15	6.80	3.45	2.90	3.60	2.40	2.00
25	3.40	3.50	6.00	9.75	6.20	10.50	6.40	3.40	2.90	3.60	2.40	2.00
26	3.40	3.50	6.00	9.50	6.00	14.70	6.10	3.40	2.90	3.50	2.40	2.00
27	3.30	3.60	5.90	11.65	5.95	13.70	5.85	3.40	2.90	3.50	2.40	2.00
28	3.30	3.60	5.80	10.40	5.80	12.00	5.60	3.35	2.90	3.45	2.40	2.00
29	3.30	3.60	5.80	10.30	10.25	10.70	5.30	3.30	2.90	3.40	2.30	2.00
30	3.30	.....	5.70	8.50	15.50	10.05	5.15	3.30	3.10	3.40	2.30	1.90
31	3.20	.....	5.70	.....	11.80	.....	4.95	3.25	.....	3.30	.....	1.90

Rating table for Kansas River at Lecompton, Kans., from January 1 to July 5, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	3,350	4.70	7,100	6.30	11,870	8.80	22,410
3.10	3,530	4.80	7,360	6.40	12,220	9.00	23,400
3.20	3,720	4.90	7,630	6.50	12,580	9.20	24,400
3.30	3,910	5.00	7,900	6.60	12,950	9.40	25,420
3.40	4,110	5.10	8,170	6.70	13,330	9.60	26,450
3.50	4,310	5.20	8,450	6.80	13,710	9.80	27,510
3.60	4,520	5.30	8,730	6.90	14,100	10.00	28,600
3.70	4,730	5.40	9,020	7.00	14,500	10.50	31,460
3.80	4,950	5.50	9,310	7.20	15,310	11.00	34,520
3.90	5,170	5.60	9,610	7.40	16,130	11.50	37,700
4.00	5,400	5.70	9,910	7.60	16,970	12.00	41,040
4.10	5,630	5.80	10,220	7.80	17,830	12.50	44,450
4.20	5,870	5.90	10,540	8.00	18,700	13.00	47,900
4.30	6,110	6.00	10,860	8.20	19,590	13.50	51,400
4.40	6,350	6.10	11,190	8.40	20,500	14.00	54,900
4.50	6,600	6.20	11,530	8.60	21,440	15.00	61,900
4.60	6,850						

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined. On account of the shifting character of the stream bed it can only be considered a rough approximation.

Rating table for Kansas River at Lecompton, Kans., from July 6 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	2,530	3.50	5,510	5.20	10,370	9.00	27,800
2.00	2,680	3.60	5,750	5.40	11,050	9.50	30,780
2.10	2,830	3.70	5,990	5.60	11,740	10.00	33,900
2.20	2,980	3.80	6,240	5.80	12,450	10.50	37,230
2.30	3,140	3.90	6,490	6.00	13,200	11.00	40,700
2.40	3,300	4.00	6,750	6.20	13,990	11.50	44,290
2.50	3,470	4.10	7,020	6.40	14,820	12.00	48,000
2.60	3,640	4.20	7,290	6.60	15,670	13.00	56,000
2.70	3,820	4.30	7,570	6.80	16,540	14.00	64,600
2.80	4,010	4.40	7,860	7.00	17,450	15.00	73,700
2.90	4,200	4.50	8,150	7.20	18,380	16.00	83,200
3.00	4,400	4.60	8,450	7.40	19,340	17.00	93,000
3.10	4,610	4.70	8,750	7.60	20,320	18.00	103,000
3.20	4,830	4.80	9,060	7.80	21,320	19.00	113,000
3.30	5,050	4.90	9,380	8.00	22,350	20.00	123,000
3.40	5,280	5.00	9,700	8.50	24,990	21.00	133,000

The above table is applicable only for open-channel conditions. It is based upon 2 discharge measurements made during 1904, and upon the general form of the curves for 1903 and the first part of 1904. It is not well defined. (See note to preceding table.)

Estimated monthly discharge of Kansas River at Lecompton, Kans., for 1904.[a]

[Drainage area, 58,550 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	5,400	3,720	4,520	277,900	0.077	0.089
February	4,520	3,350	3,783	217,600	.065	.070
March	10,860	3,350	5,464	336,000	.093	.107
April	38,350	7,360	12,900	767,600	.220	.246
May	65,400	7,900	16,020	985,000	.274	.316
June	59,800	11,530	25,290	1,505,000	.432	.482
July	130,000	9,700	36,190	2,225,000	.618	.712
August	9,060	4,830	6,198	381,100	.106	.122
September	4,830	4,200	4,433	263,800	.076	.085
October	6,750	5,050	6,073	373,400	.104	.120
November	4,830	3,140	3,704	220,400	.063	.070
December	3,140	2,530	2,891	177,800	.049	.056
The year	130,000	2,530	10,620	7,731,000	.181	2.48

[a] The above monthly estimates are only very rough approximations.

REPUBLICAN RIVER AT BENKELMAN, NEBR.

This station was established May 20, 1903, by J. C. Stevens. It is located at a highway bridge between secs. 17 and 20, T. 1 N., R. 37 W., and about one-half mile east of Benkelman, Nebr., which is on the main line of the Burlington and Missouri River Railroad. The gage is a vertical 2 by 4 inch rod 6 feet long, spiked to the downstream side of the second bent from the west end of the bridge. It is read once each day by Leon L. Hines. Discharge measurements are made from the upstream side of the highway bridge, the upstream hand rail of which is marked at 5-foot intervals by notches cut into the rail. This bridge is one-fourth mile above the mouth of the South Fork of Republican River. The initial point for soundings is the zero mark on the upstream hand rail at the east end of the bridge. The channel is straight for 200 feet above and 500 feet below the station. Both banks are low and sandy, free from timber, and liable to overflow at very high stages. The bed is composed of shifting sand, and there is but one channel, except at extreme low water. The river sometimes goes dry during the summer. Bench mark No. 1 is the top of the south end of the concrete foundation for the first or west upright bent of the elevated track in the Burlington and Missouri River Railroad yards just east of the railroad station. To this bench mark the gage rods of both the Republican and South Fork of the Republican stations were referred. Its elevation above the zero of the Republican River gage is 16.14 feet. Bench marks Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the caps of the first, second, third, and fourth bents from the west end of the Republican River bridge. Their elevations above the zero of the Republican River gage are 6.88, 6.74, 6.34, and 6.19 feet, respectively.

A station was maintained on this stream from November 1, 1894, to September 7, 1895, the gagings being made several miles farther upstream. A description of this station and the results of the observations are given on page 125 of bulletin No. 140.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Republican River at Benkelman, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 3	J. C. Stevens	125	72	1.55	1.10	112
April 18	Adna Dobson	.....	.....	.....	1.02	32
June 16	J. C. Stevens	149	47	1.85	1.10	87
December 7	J. A. Green	.....	.....	.....	1.50	136

Mean daily gage height, in feet, of Republican River at Benkelman, Nebr., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	.....	1.00	1.10	1.25	1.00	1.10	1.60	0.80	1.15	1.20	1.20
2	1.40	.....	.95	1.10	1.30	1.10	1.15	1.40	.70	1.15	1.20	1.30
3	1.35	.....	1.10	1.10	1.10	1.25	1.10	1.00	.80	1.30	1.20	1.20
4	1.30	.....	.90	1.10	1.25	1.60	1.20	1.20	.70	1.70	1.20	(c)
5	1.30	.....	.90	1.10	1.20	1.05	1.10	1.10	.70	1.00	1.20	.....
6	1.40	.....	1.05	1.10	1.20	1.10	1.05	.....	.75	1.00	1.20	.....
7	1.50	.....	.90	1.20	1.20	1.00	1.75	.....	.80	1.00	1.20	1.50
8	1.60	.....	.95	.....	1.00	1.00	.....	1.10	.90	1.00	1.15	.....
9	1.60	.....	1.10	1.10	1.00	1.10	1.25	1.05	.90	1.00	.....	.....
10	1.60	.....	1.05	1.05	1.05	1.40	1.20	1.00	.90	1.10	1.15	.....
11	1.50	.....	1.00	1.10	1.00	1.20	1.10	.90	.90	1.10	1.15	.....
12	1.45	.....	1.00	1.00	.95	1.20	1.00	1.10	.85	1.00	1.15	.....
13	1.30	.....	1.05	1.00	.90	1.40	1.00	.80	.85	1.05	1.20	.....
14	1.45	.....	1.00	1.00	.90	1.20	.90	.80	.85	1.00	1.15	.....
15	1.55	.....	1.10	1.00	1.05	1.20	1.00	.80	.80	1.05	1.25	.....
16	1.45	.....	1.00	1.05	1.00	1.10	.90	.80	.....	1.00	1.15	.....
17	1.45	.....	1.00	1.60	1.00	1.35	.85	.80	.90	1.05	1.20	.....
18	1.45	.....	.80	1.00	1.00	1.35	.80	.80	.85	.....	1.15	.....
19	1.30	.....	.95	1.00	1.00	1.10	.90	.90	.85	1.60	1.15	.....
20	1.30	.....	1.00	1.00	1.00	1.00	1.20	.90	.85	1.30	1.20	.....
21	.90	.....	1.05	1.00	1.05	1.10	1.00	.....	.85	1.30	1.15	.....
22	.90	.....	1.00	1.05	1.10	1.15	1.00	.90	.85	1.20	1.20	.....
23	1.00	.....	1.05	1.00	1.20	1.25	.90	.85	.85	1.20	1.30	.....
24	(b)	.....	1.05	.....	1.00	1.80	1.10	.80	.85	1.15	1.20	.....
25	.....	.....	1.05	1.20	1.00	1.20	.90	.80	.90	1.20	1.15	.....
26	.....	.....	1.00	1.20	1.00	1.15	.80	.80	.90	1.10	1.20	.....
27	.....	(b)	1.05	1.10	1.05	1.15	.80	.80	.90	1.20	1.25	.....
28	.....	0.95	1.00	1.05	1.10	1.10	.80	.80	.....	1.20	.....	.....
29	.....	.95	1.05	1.00	1.00	1.15	.80	.80	1.10	1.20	.....	.....
30	.....	.....	1.10	1.30	1.00	1.15	.75	.80	1.10	1.20	1.30	.....
31	.....	.....	1.10	.....	1.00	.....	.75	.80	.....	1.20	.....	.....

[a] River frozen during January.
[b] No gage-height observations January 24 to February 27, inclusive.
[c] Ice.

Mean daily discharge, in second-feet, of Republican River at Benkelman, Nebr., for 1904.[a]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	87	111	87	55	46	165	10	55	65	65
2	.....	76	111	99	76	55	111	0	55	65	87
3	.....	111	111	55	111	46	30	10	87	65	65
4	.....	65	111	87	211	65	65	0	195	65	.....
5	.....	65	111	76	65	46	46	0	30	65	.....
6	.....	99	111	76	76	38	46	5	30	65	.....
7	.....	65	124	76	55	211	46	10	30	65	136
8	.....	76	105	38	55	143	46	17	30	55	.....
9	.....	111	87	38	76	76	38	17	30	55	.....
10	.....	99	76	46	151	65	30	17	46	55	.....
11	.....	87	87	38	99	46	17	17	46	55	.....
12	.....	87	46	30	99	30	46	13	30	55	.....
13	.....	99	46	23	151	30	10	13	38	65	.....
14	.....	87	38	23	99	17	10	13	30	55	.....
15	.....	111	38	46	99	30	10	10	38	76	.....
16	.....	87	38	46	87	17	10	14	30	55	.....
17	.....	87	30	46	137	13	10	17	38	65	.....
18	.....	46	30	46	137	10	10	13	101	55	.....
19	.....	76	30	46	65	17	17	13	165	55	.....
20	.....	87	30	46	46	65	17	13	87	65	.....
21	.....	99	30	55	65	30	17	13	87	55	.....
22	.....	87	38	65	76	30	17	13	65	65	.....
23	.....	99	30	87	87	17	13	13	65	87	.....
24	.....	99	47	46	227	46	10	13	55	65	.....
25	.....	99	65	46	65	17	10	17	65	55	.....
26	.....	65	65	46	55	10	10	17	46	65	.....
27	.....	99	46	55	55	10	10	17	65	76	.....
28	76	87	38	65	46	10	10	31	65	80	.....
29	76	99	30	46	55	10	10	46	65	83	.....
30	.....	111	87	46	55	5	10	46	65	87	.....
31	.....	111	.....	46	.....	5	10	.....	65	.....	.....

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq. Discharge interpolated for days when the gage was not observed.

Estimated monthly discharge of Republican River at Benkelman, Nebr., for 1904.

[Drainage area, 3,965 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	111	46	89.1	5,478	0.022	0.025
April	124	30	64.9	3,862	.016	.018
May	99	23	53.9	3,314	.014	.016
June	227	46	91.2	5,427	.023	.026
July	211	5	40.5	2,490	.010	.012
August	165	10	29.3	1,802	.0074	.0085
September	46	0	14.9	887	.0038	.0042
October	195	30	61.3	3,769	.015	.017
November	87	55	64.6	3,844	.016	.018
The period				30,870		

NOTE.—Insufficient measurements were made during 1904 to make the above monthly estimates other than a rough approximation.

REPUBLICAN RIVER (SOUTH FORK) NEAR BENKELMAN, NEBR.

This station was established May 20, 1903, by J. C. Stevens. It is located at a highway bridge between secs. 17 and 20, T. 1 N., R. 37 W., and about three-fourths of a mile east of Benkelman, Nebr. The South Fork empties into Republican River about one-fourth of a mile below this station. A station is also maintained on Republican River one-fourth of a mile above the junction of the two streams. The gage is a vertical 2 by 4 inch rod 5½ feet long, spiked to the upstream side of the first bent in the channel from the east bank of the stream. It is read once each day by Leon L. Hines. Discharge measurements are made from the upstream side of the highway bridge to which the gage is attached. The upstream hand rail of this bridge is marked at 5-foot intervals by notches cut into the rail, and the initial point for soundings is the zero mark on the rail at the east end of the bridge. The channel is straight for 1,000 feet above and 500 feet below the station. Both banks are low and sandy, free from timber, and liable to overflow at very high stages. The bed of the stream is sandy and shifting, and there is but one channel except at extremely low stages. The river usually goes dry during the summer. Bench mark No. 1 is the top of the south end of the concrete foundation for the first or west upright bent of the elevated track in the Burlington and Missouri River Railroad yards just east of the station. Its eleva-

tion above the zero of the South Fork gage is 18.29 feet. This is also bench mark No. 1 of the Republican River gage. Bench marks Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the first, second, third, and fourth bents from the west end of the South Fork bridge. Their elevations above the zero of the South Fork gage are 6.62, 6.48, 6.38, and 6.20 feet, respectively.

A station was maintained on this river from November 1, 1894, to September 7, 1895, the gagings being made near the present station. A description of the old station and the results of the observations are given on page 130 of Bulletin No. 140.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Republican River (South Fork) near Benkelman, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 3	J. C. Stevens	65	24	1.32	1.20	32
April 18	Adna Dobson	106	76	1.87	1.70	142
June 16	J. C. Stevens	106	77	1.88	1.70	145
June 16	do				1.10	14
December 7	J. A. Green				1.32	32

Mean daily gage height, in feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	.....	1.35	1.20	1.50	1.50	1.35	1.00	1.05	1.30	1.50	1.30
2	1.50	.....	1.40	1.15	1.55	1.55	1.40	1.50	1.05	1.25	1.50	1.30
3	1.40	.....	1.30	1.20	1.50	1.60	1.50	1.00	1.05	1.25	1.50	1.30
4	1.30	.....	1.40	1.20	1.50	1.40	1.55	1.20	1.00	1.30	1.50	(c)
5	1.30	.....	1.55	1.20	1.70	1.60	1.40	1.10	1.00	1.30	1.50	.....
6	1.40	.....	1.50	1.20	1.50	1.55	1.50	.....	1.00	1.25	1.50	.....
7	1.40	.....	1.35	1.00	1.50	1.50	1.30	.....	1.00	1.30	1.50	1.32
8	1.40	.....	1.40	.....	1.50	1.45	.....	1.00	1.00	1.40	1.45	.....
9	1.40	.....	1.40	1.00	1.40	1.60	1.60	1.50	1.00	1.30	.....	.....
10	1.40	.....	1.40	1.05	1.45	1.75	1.55	1.40	1.00	1.40	1.40	.....
11	1.55	.....	1.30	1.10	1.40	2.15	1.50	1.30	1.00	1.40	1.50	.....
12	1.60	.....	1.40	1.10	1.35	1.80	1.20	1.10	1.00	1.30	1.50	.....
13	1.40	.....	1.40	1.15	1.40	1.80	1.30	1.10	1.00	1.30	1.50	.....
14	1.30	.....	1.40	1.00	1.40	1.80	1.30	1.10	1.00	1.25	1.50	.....
15	1.40	.....	1.40	.95	1.40	1.80	1.10	1.10	1.00	1.25	1.45	.....
16	1.40	.....	1.40	1.00	1.40	1.60	1.10	1.10	.....	1.25	1.45	.....
17	1.45	.....	1.40	.95	1.40	1.80	1.05	1.05	1.00	1.30	1.50	.....
18	1.50	.....	1.40	.90	1.40	1.80	1.00	1.10	.85	.....	1.45	.....
19	1.40	.....	1.40	.95	1.40	2.30	1.05	1.10	.85	1.70	1.45	.....
20	1.50	.....	1.40	.95	1.30	1.30	1.10	1.00	.85	1.70	1.45	.....
21	1.40	.....	1.40	.95	1.40	1.50	.90	.....	.85	1.60	1.45	.....
22	1.40	.....	1.40	1.05	1.50	1.55	.90	1.15	.85	1.50	1.50	.....
23	1.35	.....	1.30	1.00	1.50	1.70	.90	1.10	.85	1.50	1.40	.....
24	(b)	.....	1.25	.....	2.00	2.00	1.10	1.05	.85	1.50	1.45	.....
25	.....	.....	1.30	1.20	1.70	1.45	1.10	1.05	1.00	1.35	1.45	.....
26	.....	.....	1.20	1.20	1.60	1.45	1.00	1.05	1.00	1.40	1.45	.....
27	.....	(b)	1.25	1.30	1.80	1.40	.80	1.05	1.00	1.35	1.45	.....
28	.....	1.40	1.35	1.20	1.60	1.40	.80	1.05	.....	1.50	.....	.....
29	.....	1.40	1.30	1.20	1.50	1.30	.80	1.05	1.30	1.50	.....	.....
30	.....	.....	1.25	1.40	1.50	1.30	.85	1.06	1.30	1.55	1.40	.....
31	.....	.....	1.25	.....	1.45	.....	.85	1.06	.....	1.50	.....	.....

[a] River partially frozen during January.
[b] No observations at gage January 24 to February 27.
[c] Ice.

Mean daily discharge, in second-feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904. [a]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	57	31	89	89	57	11	15	47	66	31
2	66	25	102	102	66	89	15	39	66	31
3	47	31	89	115	89	11	15	39	66	31
4	66	31	89	66	102	31	11	47	66	.....
5	102	31	145	115	66	19	11	47	66	.....
6	89	31	89	102	89	16	11	39	66	.....
7	57	11	89	89	47	14	11	47	66	32
8	89	11	89	78	81	11	11	66	57	.....
9	66	11	66	115	115	89	11	47	52	.....
10	66	15	78	161	102	66	11	66	47	.....
11	47	19	66	328	89	47	11	66	66	.....
12	66	19	57	178	31	19	11	47	66	.....
13	66	15	66	178	47	19	11	47	66	.....
14	66	11	66	178	47	19	11	39	66	.....
15	66	8	66	178	19	19	11	39	57	.....
16	66	11	66	115	19	19	11	39	57	.....
17	66	8	66	178	15	15	11	31	66	.....
18	66	6	66	178	11	19	5	73	57	.....
19	66	8	66	397	15	19	5	115	57	.....
20	66	8	47	47	11	11	5	115	57	.....
21	66	8	66	89	6	18	5	89	57	.....
22	66	15	89	102	6	25	5	66	66	.....
23	47	11	89	145	6	19	5	66	47	.....
24	39	21	255	255	19	15	5	66	57	.....
25	47	31	145	78	19	15	11	39	57	.....
26	31	31	115	78	19	15	11	47	57	.....
27	39	47	178	66	5	15	11	39	57	.....
28	57	31	115	66	5	15	29	66	54	.....
29	47	31	89	47	5	15	47	66	50	.....
30	39	66	89	47	5	15	47	78	47	.....
31	39	.....	78	.....	5	15	.....	66	.....	.....

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

Discharge interpolated for days when the gage was not observed.

Estimated monthly discharge of Republican River (South Fork) near Benkelman, Nebr., for 1904.[a]

[Drainage area, 5,910 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	102	31	60.1	3,695	0.010	0.012
April	36	6	21.1	1,256	.0036	.0040
May	255	47	92.4	5,682	.016	.018
June	397	47	132	7,855	.022	.025
July	115	5	39.3	2,416	.0066	.0076
August	89	11	24.0	1,476	.0041	.0047
September	47	5	13.0	774	.0022	.0025
October	115	31	57.5	3,536	.010	.012
November	66	47	59.4	3,534	.010	.011
The period				30,220		

[a] Insufficient measurements were made during 1904 to make the above monthly estimate other than a rough approximation.

REPUBLICAN RIVER NEAR BOSTWICK, NEBR.

This station was established June 6, 1904, by J. C. Stevens. It is located at the highway bridge, 1 mile southwest of Bostwick, Nebr., a station on the Burlington and Missouri River Railroad, and replaces the station formerly maintained at Superior, Nebr. A standard chain gage is fastened to the downstream hand rail in the second panel from the south end of the north span. The length of the chain from the end of the weight to the marker is 20.52 feet. The gage is read once each day by M. A. McPherson. Discharge measurements are made from the bridge to which the gage is attached. This bridge has three 150-foot spans resting on tubular concrete piers. The downstream hand rail is marked every 10 feet with Roman numerals. The initial point for soundings is the zero mark on the hand rail, which is in line with the south face of the north downstream pier. The channel is straight for about 1,000 feet above and below the station, and the current is not sluggish. The right bank is low, timbered, and subject to overflow during high water. The left bank is high, timbered, and does not overflow. The bed of the stream is composed of sand and is shifting. The depths are fairly uniform. There is but one channel, except at extreme low stages. There is some tendency to form small islands in all parts of the channel. The bench mark is the top of the cast-iron bearing shoe of the upper chord of the north span, downstream truss, at the north end of the span. The shoe rests on rollers on the top of the pier and has three openings. The east opening is the bench mark. Its elevation is 15.75 feet above the datum of the gage. Bench mark No. 2 is the northeast cardinal point of the rim or

edge of the cover plate of the pier at the south end of truss described above. Its elevation is 15.89 feet above the gage datum.

The object in moving the station from Superior to Bostwick was to obtain a greater degree of accuracy than could possibly be obtained at the former place on account of the complicated conditions existing there in the way of dam, mill race, etc.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

Discharge measurements of Republican River near Bostwick, Nebr., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 5	J. C. Stevens	407	510	1.73	2.10	884
June 6	do	428	682	1.89	2.64	1,289
June 29	do	437	993	2.39	3.50	2,379
July 8	R. D. Hubbard	430	761	2.36	3.05	1,799
August 16	do		257	1.55	1.50	397
December 8	J. A. Green				1.70	520

Mean daily gage height, in feet, of Republican River near Bostwick, Nebr., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.90	1.45	1.40	1.40	1.60	1.70
2		2.70	1.40	1.25	1.35	1.70	(a)
3		2.65	1.40	1.20	1.30	1.75	
4		3.70	1.45	1.30	1.35	1.70	
5		6.10	1.50	1.40	1.40	1.70	
6	2.40	6.25	1.75	1.25	1.35	1.70	
7	2.20	3.70	1.70	1.30	1.35	1.65	
8	1.60	3.05	2.30	1.25	1.30	1.65	
9	2.10	3.07	2.20	1.15	1.35	1.70	
10	2.15	3.90	1.90	1.25	1.30	1.65	
11	2.00	3.40	1.70	1.25	1.35	1.65	
12	2.00	3.10	1.60	1.20	1.40	1.65	
13	1.95	3.25	1.60	1.20	1.35	1.65	
14	1.90	3.10	1.55	1.10	1.45	1.70	
15	3.10	2.75	1.50	1.05	1.40	1.65	
16	2.95	2.55	1.45	1.00	1.50	1.70	
17	2.40	2.30	1.45	1.00	1.45	1.70	
18	2.45	2.15	1.60	.95	1.40	1.70	
19	2.75	2.05	b1.50	.90	1.45	1.65	
20	2.45	2.00	2.30	1.00	2.00	1.70	
21	2.75	2.00	1.85	.95	2.40	1.70	
22	2.50	1.95	1.70	1.00	2.30	1.70	
23	2.55	1.90	1.45	1.00	2.30	1.65	
24	3.68	1.85	1.45	.95	2.25	1.70	
25	4.10	1.80	1.40	1.00	2.15	1.70	
26	4.90	1.75	1.35	.95	2.10	1.70	
27	4.80	1.70	1.40	1.00	2.05	1.70	
28	3.85	1.65	1.35	1.15	1.95	1.70	
29	3.50	1.50	1.25	1.20	1.80	1.70	
30	3.10	1.50	1.40	1.30	1.70	1.70	
31		1.45	1.50		1.65		

a River frozen over. b Gage height estimated. No gage reading taken, owing to sand at the gage.

Rating table for Republican River near Bostwick Nebr., from June 6 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	60	2.30	1,020	3.70	2,670	5.10	5,010
1.00	110	2.40	1,115	3.80	2,815	5.20	5,210
1.10	160	2.50	1,210	3.90	2,965	5.30	5,410
1.20	215	2.60	1,310	4.00	3,115	5.40	5,610
1.30	275	2.70	1,415	4.10	3,265	5.50	5,820
1.40	335	2.80	1,525	4.20	3,420	5.60	6,030
1.50	400	2.90	1,635	4.30	3,580	5.70	6,240
1.60	465	3.00	1,750	4.40	3,750	5.80	6,460
1.70	535	3.10	1,870	4.50	3,920	5.90	6,680
1.80	605	3.20	1,995	4.60	4,090	6.00	6,900
1.90	680	3.30	2,120	4.70	4,270	6.10	7,130
2.00	760	3.40	2,250	4.80	4,450	6.20	7,360
2.10	845	3.50	2,385	4.90	4,630	6.30	7,600
2.20	930	3.60	2,525	5.00	4,820		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is well defined between gage heights 1.5 feet and 3.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Republican River near Bostwick, Nebr., for 1904.

[Drainage area, 23,270 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
June 6–30	4,630	400	1,666	82,610	0.072	0.067
July	7,480	367	1,658	101,900	.071	.082
August	1,020	245	472	29,020	.020	.023
September	335	60	181	10,770	.0078	.0087
October	1,115	275	514	31,600	.022	.025
November	570	465	523	31,120	.022	.025
The period				287,000		

REPUBLICAN RIVER AT JUNCTION, KANS.

The gaging station at this point, established by Arthur P. Davis, April 26, 1895, is located at the wagon bridge at the north end of Washington street, just above the mouth of the river. The gage consists of two oak timbers bolted to a post and to a cottonwood tree. The observer is J. H. Rathert. The channel is straight for 300 feet above and below the station, broken by three piers. The right bank is high, but the left is low and may overflow at high water. The bed of the stream is sandy and liable to change. The flow is moderately rapid.

On October 23, 1900, a bench mark was established at an elevation of 12.35 feet above the zero of the old gage. It is a spike driven in the west side of a cottonwood tree 18 inches in diameter and 10 feet west of the bridge. The spike is about 2 feet above the ground. The second bench mark, established March 15, 1904, is the top of a stone at base of abutment south of No. 3. The elevation is 14.28 feet above the zero of the gage. The high water of 1904 made a second channel north of the bridge. The county put in a pile bridge 220 feet long across this, and November 4, 1904, the channel was 158 feet wide and carried about three-fourths of the water in the river.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Republican River at Junction, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 15	W. G. Russell	163	339	2.56	4.10	868
April 26	do		2,044	5.74	8.80	11,730
June 5	M. C. Hinderlider	295	1,655	5.37	8.35	8,887
July 8	W. G. Russell	476	3,085	4.76	10.40	14,700
July 9	do	458	2,855	4.59	9.95	13,100
July 21	Russell and Murphy	245	594	3.56	4.50	2,113
November 4	do	192	433	1.90	3.40	824

Mean daily gage height, in feet, of Republican River at Junction, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	3.97	4.40	4.30	3.85	4.35	7.60	6.55	3.60	3.20	3.00	3.50	3.30
2	4.20	4.40	4.30	3.90	4.15	5.80	6.05	3.75	3.20	3.00	3.50	3.30
3	4.20	4.40	5.05	4.05	3.95	6.10	5.70	3.70	3.18	3.00	3.50	3.30
4	4.20	4.40	5.10	4.00	3.85	7.70	6.85	3.85	3.08	3.00	3.45	3.30
5	4.20	4.40	4.72	3.90	3.72	8.58	6.85	3.85	3.30	3.00	3.40	3.30
6	4.20	4.40	4.60	3.90	3.95	6.28	10.65	3.65	3.12	3.00	3.40	3.30
7	4.25	4.40	4.48	3.80	3.90	5.70	9.90	3.58	3.02	3.00	3.40	3.20
8	4.35	4.40	4.40	3.80	5.70	5.30	10.45	3.45	3.00	3.00	3.40	3.20
9	4.35	4.40	4.32	3.80	6.78	5.20	9.52	3.50	3.02	3.00	3.40	3.20
10	4.40	4.40	4.30	3.80	6.50	6.95	7.55	3.40	3.00	2.90	3.40	3.20
11	4.35	4.40	4.30	3.80	5.70	7.25	6.40	3.45	3.10	2.90	3.40	3.20
12	4.35	4.35	4.30	3.80	5.05	7.30	6.40	4.05	3.00	2.90	3.40	3.20
13	4.75	4.30	4.22	3.80	4.78	5.35	6.70	3.92	3.08	3.00	3.40	3.12
14	5.02	4.35	4.28	3.80	4.65	4.75	5.55	3.70	3.00	3.00	3.30	3.10
15	4.75	4.40	4.20	3.80	4.55	6.50	5.35	3.50	3.00	3.00	3.30	3.10
16	4.45	4.40	4.25	3.80	4.60	10.55	5.30	3.50	3.15	3.00	3.35	3.10
17	4.25	4.48	4.00	3.80	4.30	8.65	4.90	3.50	3.05	3.00	3.37	3.10
18	4.20	4.50	3.90	3.80	4.10	7.05	4.70	3.50	3.02	3.00	3.30	3.10
19	4.20	4.65	4.00	3.80	4.02	6.10	4.40	3.65	2.95	4.00	3.30	3.12
20	4.28	4.72	4.00	4.30	3.88	5.45	4.52	3.50	3.00	4.00	3.30	3.25
21	4.20	4.80	4.00	4.40	3.78	5.65	4.50	3.48	3.00	3.15	3.30	3.45
22	3.70	4.68	3.90	4.10	3.70	6.05	4.70	3.55	2.70	3.10	3.30	3.52
23	3.50	4.40	3.90	4.97	3.70	5.90	4.15	3.35	2.60	3.10	3.30	3.52
24	3.40	4.32	3.90	4.80	3.70	5.55	3.90	4.30	2.65	3.15	3.30	3.40
25	3.40	4.30	4.00	7.50	3.70	12.05	3.90	3.95	2.70	3.65	3.30	3.40
26	3.40	4.30	4.40	9.10	3.60	12.85	3.80	3.70	2.45	3.75	3.30	3.40
27	3.40	4.30	4.10	7.55	3.60	10.95	3.78	3.45	2.65	3.40	3.30	3.40
28	3.40	4.30	3.90	6.60	4.10	9.00	3.70	3.40	2.60	3.30	3.30	3.40
29	3.40	4.30	3.90	5.50	8.60	7.75	3.65	3.35	2.85	3.30	3.30	3.55
30	3.90	.....	3.98	4.58	5.70	7.40	3.65	3.22	3.00	3.50	3.30	3.65
31	4.40	.....	3.90	.....	5.35	.....	3.65	3.20	.....	3.50	.....	3.80

River frozen January 3–8; January 24 to February 11; February 21–22.

Rating table for Republican River at Junction, Kans., from January 1 to May 28, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	400	4.60	1,480	5.80	3,200	7.00	6,000
3.50	455	4.70	1,600	5.90	3,400	7.20	6,600
3.60	510	4.80	1,720	6.00	3,600	7.40	7,200
3.70	570	4.90	1,840	6.10	3,800	7.60	7,800
3.80	630	5.00	1,960	6.20	4,000	7.80	8,400
3.90	735	5.10	2,085	6.30	4,200	8.00	9,000
4.00	840	5.20	2,210	6.40	4,400	8.20	9,600
4.10	945	5.30	2,365	6.50	4,650	8.40	10,200
4.20	1,050	5.40	2,520	6.60	4,900	8.60	10,900
4.30	1,155	5.50	2,680	6.70	5,150	8.80	11,400
4.40	1,260	5.60	2,840	6.80	5,400	9.00	12,000
4.50	1,370	5.70	3,020	6.90	5,700		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements of 1902 and 1903 and one in 1904. It is fairly well defined between 3.6 feet and 9 feet.

Rating table for Republican River at Junction, Kans., from May 29 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	220	3.90	1,295	5.30	3,010	7.40	6,650
2.50	260	4.00	1,400	5.40	3,150	7.60	7,080
2.60	305	4.10	1,510	5.50	3,295	7.80	7,530
2.70	355	4.20	1,620	5.60	3,440	8.00	8,000
2.80	410	4.30	1,735	5.70	3,590	8.20	8,480
2.90	470	4.40	1,850	5.80	3,745	8.40	8,980
3.00	530	4.50	1,970	5.90	3,900	8.60	9,490
3.10	595	4.60	2,090	6.00	4,060	8.80	10,010
3.20	665	4.70	2,215	6.20	4,390	9.00	10,550
3.30	740	4.80	2,340	6.40	4,730	9.50	11,950
3.40	820	4.90	2,470	6.60	5,085	10.00	13,450
3.50	905	5.00	2,600	6.80	5,450	10.50	15,030
3.60	995	5.10	2,735	7.00	5,830	11.00	16,700
3.70	1,090	5.20	2,870	7.20	6,230	12.00	20,200
3.80	1,190						

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is fairly well defined between gage heights 3.4 feet and 10.5 feet. The table has been extended beyond these limits. Owing to the shifting character of the bed, the insufficiency of measurements may lead to some error in the application of this table.

Estimated monthly discharge of Republican River at Junction, Kans., for 1904.

[Drainage area, 25,840 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January [a]	1,985	400	990	60,870	0.038	0.044
February [a]	1,720	1,155	1,288	74,090	.050	.054
March	2,085	735	1,081	66,470	.042	.048
April	12,300	630	1,877	111,700	.073	.081
May	9,490	510	1,764	108,500	.068	.078
June	23,300	2,278	7,083	421,500	.274	.306
July	15,520	1,042	4,321	265,700	.167	.192
August	1,735	665	1,007	61,920	.039	.045
September	740	240	510	30,350	.020	.022
October	1,400	470	674	41,440	.026	.030
November	905	740	788	46,890	.030	.033
December	1,190	595	747	45,930	.029	.033
The year	23,300	240	1,844	1,335,000	.071	.966

[a] River frozen part of January and February. Estimates given above are for open channel, and are probably slightly in error.

SMOKY HILL RIVER AT ELLSWORTH, KANS.

This station, established April 16, 1895, by A. P. Davis, is located at the highway bridge on Douglass avenue, Ellsworth, Kans. The gage is in two sections. The first section is an inclined ash timber, graduated to read direct in feet and tenths from zero to 4 feet, securely fastened to the iron pier of the bridge and to posts driven into the bed of the river. The second section is a 2 by 6 inch timber 17 feet long spiked to the same pier. It is graduated to feet and tenths from 3.7 feet to 21 feet. The gage is read once each day by Thomas Coyne. Discharge measurements are made from the downstream side of the three-span steel bridge, 293 feet long between abutments. The spans are supported at interior points by four iron posts under each corner. The initial point for soundings is at the north end on the downstream side of the bridge. The channel is straight above and below the station during high water; at other times it is slightly curved. The current is moderate at low, and swift at high stages. Both banks are low, wooded, and subject to overflow. The bed of the stream is composed of sand, free from vegetation and shifting. Bench mark No. 1 is a nail driven into the base of a box-elder tree near the southeast corner of the bridge, 90 feet from the gage. Its elevation is 13.07

feet above the zero of the gage. Bench mark No. 2 is the top of a nail driven into a root on the north side of an elm tree 2 feet in diameter about 45 feet west of bench mark No. 1. Its elevation is 11.34 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Smoky Hill River at Ellsworth, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 11	W. G. Russell	60	38	1.47	1.20	56
September 30	do	64	56	1.46	1.45	82

Mean daily gage height, in feet, of Smoky Hill River at Ellsworth, Kans., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.15	1.1	0.9	1.05	1.15	1.3	5.5	1.9	1.45	3.0	1.2	0.95
2	.....	1.2	.85	1.0	1.1	1.25	7.6	1.8	1.4	2.0	1.15	1.0
3	.....	1.2	.85	1.0	1.1	[b]4.8	4.3	1.7	1.4	1.6	1.15	1.0
4	.....	1.2	.85	1.0	1.3	2.4	3.6	2.0	1.4	1.55	1.15	1.0
5	.....	1.1	.85	1.0	1.4	2.1	2.7	2.0	1.35	1.5	1.15	1.0
6	.....	1.05	.85	1.05	1.8	1.9	[c]10.4	1.9	1.35	1.4	1.15	1.0
7	.....	1.0	.85	1.05	1.9	1.8	6.6	2.1	1.35	1.45	1.15	1.05
8	.....	1.0	.85	1.05	4.6	1.65	4.4	1.7	1.3	1.35	1.1	1.05
9	1.2	1.0	.85	1.0	3.3	1.5	4.8	1.6	1.3	1.3	1.1	1.05
10	1.0	[a]1.0	1.2	1.0	2.7	1.9	4.9	1.6	1.25	1.25	1.1	1.15
11	1.0	[a]1.0	1.2	1.0	2.4	1.5	3.4	1.55	1.25	1.25	1.1	1.1
12	1.2	1.0	1.25	1.0	2.2	1.5	3.1	1.5	1.2	1.2	1.05	1.1
13	1.2	1.0	1.25	1.0	2.0	1.4	2.9	1.5	1.2	1.15	1.05	1.1
14	1.15	1.2	1.25	1.0	2.0	1.4	1.7	1.4	1.2	1.1	1.1	1.05
15	1.1	1.2	1.2	1.0	1.9	1.5	1.5	1.4	1.1	1.1	1.1	1.05
16	1.1	1.2	1.2	1.0	1.8	1.5	1.35	1.4	1.1	1.1	1.1	1.05
17	1.1	1.2	1.2	1.0	1.7	1.5	1.2	1.4	1.0	1.1	1.05	1.0
18	1.1	1.2	1.15	1.0	1.6	1.6	1.1	1.5	1.0	1.05	1.05	1.0
19	1.1	1.2	1.15	1.0	1.5	1.7	1.7	2.5	1.0	1.05	1.0	1.0
20	1.1	1.2	1.15	1.05	1.5	1.7	2.3	2.2	1.0	1.05	1.0	1.05
21	1.1	1.2	1.15	1.05	1.45	1.6	2.9	2.0	1.05	1.0	1.0	1.05
22	1.1	1.2	1.1	1.05	1.4	1.5	2.8	2.2	1.1	1.0	1.0	1.1
23	1.1	1.0	1.1	1.7	1.4	1.4	3.0	2.45	1.05	1.0	1.0	1.05
24	1.1	.9	1.5	1.4	1.4	1.4	2.5	2.15	1.0	1.0	1.0	1.0
25	1.1	.9	1.2	1.25	1.35	3.3	2.1	1.9	1.0	1.3	1.0	1.0
26	1.1	.9	1.15	1.25	1.6	2.15	1.9	1.8	1.0	1.25	1.0	1.0
27	1.1	.9	1.1	1.25	1.35	1.9	1.9	1.75	2.0	1.2	.95	(a)
28	1.1	.9	1.05	1.2	1.35	1.7	1.85	1.7	1.5	1.2	.95	
29	1.1	.9	1.05	1.2	1.9	2.3	1.8	1.6	1.9	1.2	.95	
30	1.1	.....	1.0	1.2	1.4	2.2	1.7	1.55	1.6	1.2	.95	
31	1.1	.....	1.0	.....	1.35	.....	2.0	1.5	.....	1.2	.....	

[a] River frozen January 1 to February 22; also December 27-31.
[b] At 6 a. m. gage read 7.0. At 2 p. m. gage read 4.8.
[c] At 9 a. m. gage read 11.0. At 2 p. m. gage read 9.8.

Mean daily gage height, in feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	.....	1.35	1.20	1.50	1.50	1.35	1.00	1.05	1.30	1.50	1.30
2	1.50	.....	1.40	1.15	1.55	1.55	1.40	1.50	1.05	1.25	1.50	1.30
3	1.40	.....	1.30	1.20	1.50	1.60	1.50	1.00	1.05	1.25	1.50	1.30
4	1.30	.....	1.40	1.20	1.50	1.40	1.55	1.20	1.00	1.30	1.50	(c)
5	1.30	.....	1.55	1.20	1.70	1.60	1.40	1.10	1.00	1.30	1.50	.....
6	1.40	.....	1.50	1.20	1.50	1.55	1.50	.....	1.00	1.25	1.50	.....
7	1.40	.....	1.35	1.00	1.50	1.50	1.30	.....	1.00	1.30	1.50	1.32
8	1.40	.....	1.40	.....	1.50	1.45	.....	1.00	1.00	1.40	1.45	.....
9	1.40	.....	1.40	1.00	1.40	1.60	1.60	1.50	1.00	1.30	.....	.....
10	1.40	.....	1.40	1.05	1.45	1.75	1.55	1.40	1.00	1.40	1.40	.....
11	1.55	.....	1.30	1.10	1.40	2.15	1.50	1.30	1.00	1.40	1.50	.....
12	1.60	.....	1.40	1.10	1.35	1.80	1.20	1.10	1.00	1.30	1.50	.....
13	1.40	.....	1.40	1.15	1.40	1.80	1.30	1.10	1.00	1.30	1.50	.....
14	1.30	.....	1.40	1.00	1.40	1.80	1.30	1.10	1.00	1.25	1.50	.....
15	1.40	.....	1.40	.95	1.40	1.80	1.10	1.10	1.00	1.25	1.45	.....
16	1.40	.....	1.40	1.00	1.40	1.60	1.10	1.10	.....	1.25	1.45	.....
17	1.45	.....	1.40	.95	1.40	1.80	1.05	1.05	1.00	1.30	1.50	.....
18	1.50	.....	1.40	.90	1.40	1.80	1.00	1.10	.85	.....	1.45	.....
19	1.40	.....	1.40	.95	1.40	2.30	1.05	1.10	.85	1.70	1.45	.....
20	1.50	.....	1.40	.96	1.30	1.30	1.10	1.00	.85	1.70	1.45	.....
21	1.40	.....	1.40	.95	1.40	1.50	.90	.....	.85	1.60	1.45	.....
22	1.40	.....	1.40	1.05	1.50	1.55	.90	1.15	.85	1.50	1.50	.....
23	1.35	.....	1.30	1.00	1.50	1.70	.90	1.10	.85	1.50	1.40	.....
24	(b)	.....	1.25	.....	2.00	2.00	1.10	1.05	.85	1.50	1.45	.....
25	.....	.....	1.30	1.20	1.70	1.45	1.10	1.05	1.00	1.35	1.45	.....
26	.....	.....	1.20	1.20	1.60	1.45	1.00	1.05	1.00	1.40	1.45	.....
27	.....	(b)	1.25	1.30	1.80	1.40	.80	1.05	1.00	1.35	1.45	.....
28	.....	1.40	1.35	1.20	1.60	1.40	.80	1.05	.....	1.50	.....	.....
29	.....	1.40	1.30	1.20	1.50	1.30	.80	1.05	1.30	1.50	.....	.....
30	.....	.....	1.25	1.40	1.50	1.30	.85	1.05	1.30	1.55	1.40	.....
31	.....	.....	1.25	.....	1.45	.....	.85	1.05	.....	1.50	.....	.....

[a] River partially frozen during January.
[b] No observations at gage January 24 to February 27.
[c] Ice.

Mean daily discharge, in second-feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904. [a]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	57	31	89	89	57	11	15	47	66	31
2	66	25	102	102	66	89	15	39	66	31
3	47	31	89	115	89	11	15	39	66	31
4	66	31	89	66	102	31	11	47	66	.....
5	102	31	145	115	66	19	11	47	66	.....
6	89	31	89	102	89	16	11	39	66	.....
7	57	11	89	89	47	14	11	47	66	32
8	89	11	89	78	81	11	11	66	57	.....
9	66	11	66	115	115	89	11	47	52	.....
10	66	15	78	161	102	66	11	66	47	.....
11	47	19	66	323	89	47	11	66	66	.....
12	66	19	57	178	31	19	11	47	66	.....
13	66	15	66	178	47	19	11	47	66	.....
14	66	11	66	178	47	19	11	39	66	.....
15	66	8	66	178	19	19	11	39	57	.....
16	66	11	66	115	19	19	11	39	57	.....
17	66	8	66	178	15	15	11	31	66	.....
18	66	6	66	178	11	19	5	73	57	.....
19	66	8	66	397	15	19	5	115	57	.....
20	66	8	47	47	11	11	5	115	57	.....
21	66	8	66	89	6	18	5	89	57	.....
22	66	15	89	102	6	25	5	66	66	.....
23	47	11	89	145	6	19	5	66	47	.....
24	39	21	255	255	19	15	5	66	57	.....
25	47	31	145	78	19	15	11	39	57	.....
26	31	31	115	78	19	15	11	47	57	.....
27	39	47	178	66	5	15	11	39	57	.....
28	57	31	115	66	5	15	29	66	54	.....
29	47	31	89	47	5	15	47	66	50	.....
30	39	66	89	47	5	15	47	78	47	.....
31	39	.....	78	.....	5	15	.....	66	.....	.....

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.
Discharge interpolated for days when the gage was not observed.

Mean daily gage height, in feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	.....	1.35	1.20	1.50	1.50	1.35	1.00	1.05	1.30	1.50	1.30
2	1.50	.....	1.40	1.15	1.55	1.55	1.40	1.50	1.05	1.25	1.50	1.30
3	1.40	.....	1.30	1.20	1.50	1.60	1.50	1.00	1.05	1.25	1.50	1.30
4	1.30	.....	1.40	1.20	1.50	1.40	1.55	1.20	1.00	1.30	1.50	(c)
5	1.30	.....	1.55	1.20	1.70	1.60	1.40	1.10	1.00	1.30	1.50	.....
6	1.40	.....	1.50	1.20	1.50	1.55	1.50	.....	1.00	1.25	1.50	.....
7	1.40	.....	1.35	1.00	1.50	1.50	1.30	.....	1.00	1.30	1.50	1.32
8	1.40	.....	1.40	.....	1.50	1.45	.....	1.00	1.00	1.40	1.45	.....
9	1.40	.....	1.40	1.00	1.40	1.60	1.60	1.50	1.00	1.30	.....	.....
10	1.40	.....	1.40	1.05	1.45	1.75	1.55	1.40	1.00	1.40	1.40	.....
11	1.55	.....	1.30	1.10	1.40	2.15	1.50	1.30	1.00	1.40	1.50	.....
12	1.60	.....	1.40	1.10	1.35	1.80	1.20	1.10	1.00	1.30	1.50	.....
13	1.40	.....	1.40	1.15	1.40	1.80	1.30	1.10	1.00	1.30	1.50	.....
14	1.30	.....	1.40	1.00	1.40	1.80	1.30	1.10	1.00	1.25	1.50	.....
15	1.40	.....	1.40	.95	1.40	1.80	1.10	1.10	1.00	1.25	1.45	.....
16	1.40	.....	1.40	1.00	1.40	1.60	1.10	1.10	.....	1.25	1.45	.....
17	1.45	.....	1.40	.95	1.40	1.80	1.05	1.05	1.00	1.30	1.50	.....
18	1.50	.....	1.40	.90	1.40	1.80	1.00	1.10	.85	.....	1.45	.....
19	1.40	.....	1.40	.95	1.40	2.30	1.05	1.10	.85	1.70	1.45	.....
20	1.50	.....	1.40	.96	1.30	1.30	1.10	1.00	.85	1.70	1.45	.....
21	1.40	.....	1.40	.96	1.40	1.50	.90	.....	.85	1.60	1.45	.....
22	1.40	.....	1.40	1.05	1.50	1.55	.90	1.15	.85	1.50	1.50	.....
23	1.35	.....	1.30	1.00	1.50	1.70	.90	1.10	.85	1.50	1.40	.....
24	(b)	.....	1.25	.....	2.00	2.00	1.10	1.05	.85	1.50	1.45	.....
25	.....	.....	1.30	1.20	1.70	1.45	1.10	1.05	1.00	1.35	1.45	.....
26	.....	.....	1.20	1.20	1.60	1.45	1.00	1.05	1.00	1.40	1.45	.....
27	.....	(b)	1.25	1.30	1.80	1.40	.80	1.05	1.00	1.35	1.45	.....
28	.....	1.40	1.35	1.20	1.60	1.40	.80	1.05	.....	1.50	.....	.....
29	.....	1.40	1.30	1.20	1.50	1.30	.80	1.05	1.30	1.50	.....	.....
30	.....	.....	1.25	1.40	1.50	1.30	.85	1.05	1.30	1.55	1.40	.....
31	.....	.....	1.25	.....	1.45	.....	.85	1.05	.....	1.50	.....	.....

[a] River partially frozen during January.
[b] No observations at gage January 24 to February 27.
[c] Ice.

Mean daily discharge, in second-feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904. [a]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	57	31	89	89	57	11	15	47	66	31
2	66	25	102	102	66	89	15	39	66	31
3	47	31	89	115	89	11	15	39	66	31
4	66	31	89	66	102	31	11	47	66	.....
5	102	31	145	115	66	19	11	47	66	.....
6	89	31	89	102	89	16	11	39	66	.....
7	57	11	89	89	47	14	11	47	66	32
8	89	11	89	78	81	11	11	66	57	.....
9	66	11	66	115	115	89	11	47	52	.....
10	66	15	78	161	102	66	11	66	47	.....
11	47	19	66	323	89	47	11	66	66	.....
12	66	19	57	178	31	19	11	47	66	.....
13	66	15	66	178	47	19	11	47	66	.....
14	66	11	66	178	47	19	11	39	66	.....
15	66	8	66	178	19	19	11	39	57	.....
16	66	11	66	115	19	19	11	39	57	.....
17	66	8	66	178	15	15	11	31	66	.....
18	66	6	66	178	11	19	5	73	57	.....
19	66	8	66	397	15	19	5	115	57	.....
20	66	8	47	47	11	11	5	115	57	.....
21	66	8	66	89	6	18	5	89	57	.....
22	66	15	89	102	6	25	5	66	66	.....
23	47	11	89	145	6	19	5	66	47	.....
24	39	21	256	255	19	15	5	66	57	.....
25	47	31	145	78	19	15	11	39	57	.....
26	31	31	115	78	19	15	11	47	57	.....
27	39	47	178	66	5	15	11	39	57	.....
28	57	31	115	66	5	15	29	66	54	.....
29	47	31	89	47	5	15	47	66	50	.....
30	39	66	89	47	5	15	47	78	47	.....
31	39	.....	78	.....	5	15	.....	66	.....	.....

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.
Discharge interpolated for days when the gage was not observed.

BLUE RIVER NEAR MANHATTAN, KANS.

The gaging station, established April 12, 1895, by A. P. Davis, is at the county bridge 4 miles north of Manhattan. The low-water gage is a chain gage on the hand railing of the bridge on the east side and south end of the bridge. It reads from zero to 14 feet from a scale spiked to the hand railing. The second section is an oak rod bolted to the north face of the south pier, and reads from 11.3 to 17 feet. The third section is a similar rod, graduated from 17 to 30 feet, bolted to the south side of the same pier. The gage is read once each day by J. M. Deckert. Discharge measurements are made from the bridge, which spans the entire channel at ordinary stages. The initial point for soundings is at the south end of the bridge. The channel is straight for 200 feet above and below the station, and has a width of 225 feet at ordinary stages. Both banks are subject to overflow during high floods, the left bank being the lower of the two. The bed of the stream is composed of sand, clay, and silt, free from vegetation, and slightly shifting. The current is sluggish at low, and swift at high stages. There is but one channel at low stages and five or more during very high floods. Bench mark No. 1 is a cross cut in the capstone of the south bridge pier immediately above the upper gage, and is 32.14 feet above gage datum. Bench mark No. 2 is a cross near the top of the second stone from the ground in the northwest corner of the south abutment. Its elevation is 27.32 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Blue River near Manhattan, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 16	W. G. Russell	204	517	1.95	5.15	1,008
April 27	do	234	4,076	4.33	18.15	17,650
June 6	M. C. Hinderlider	270	2,401	4.21	13.46	10,120
November 6	W. G. Russell	204	488	1.83	5.45	891

Mean daily gage height, in feet, of Blue River near Manhattan, Kans., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	6.0	5.2	5.7	10.0	10.9	14.6	7.1	6.6	5.5	5.6	5.3
2	6.3	5.9	5.3	6.2	9.2	10.0	10.4	7.0	6.1	5.5	5.5	5.4
3	6.2	5.6	5.3	5.8	8.7	11.5	9.1	6.9	5.9	8.3	5.5	5.4
4	6.3	5.6	5.2	5.7	8.2	12.5	10.6	6.8	6.0	7.3	5.4	5.4
5	6.4	5.6	5.0	5.6	7.0	17.0	12.6	6.8	5.8	6.7	5.5	5.3
6	6.1	5.8	5.2	5.4	7.9	13.6	22.8	6.6	5.7	6.4	5.5	5.4
7	6.0	5.8	5.2	5.5	11.5	11.0	18.9	6.6	5.6	6.2	5.5	5.4
8	5.9	7.3	5.1	5.5	10.3	8.9	17.9	6.5	5.6	6.0	5.4	5.3
9	6.2	[b]9.0	5.1	5.6	13.5	8.2	16.0	6.4	5.6	5.9	5.5	5.4
10	6.0	8.2	5.2	5.7	13.3	8.0	14.8	6.4	5.5	5.8	5.4	5.4
11	5.6	8.0	5.1	5.9	9.9	10.4	13.4	6.4	5.5	5.9	5.4	5.4
12	5.3	7.9	5.1	6.4	8.6	8.8	12.4	6.3	5.5	5.7	5.5	5.4
13	5.6	7.9	5.2	7.0	8.2	11.3	12.7	6.2	5.7	5.6	5.5	5.4
14	5.5	7.5	5.3	6.6	8.4	9.8	11.4	6.2	5.8	5.6	5.5	5.2
15	5.2	6.9	5.1	6.0	8.4	10.6	10.5	6.1	6.2	5.6	5.5	5.3
16	5.4	6.8	5.1	5.7	7.9	13.9	9.8	6.1	6.0	5.5	5.4	5.5
17	5.3	6.6	5.2	5.5	7.8	11.2	9.5	6.0	5.7	5.5	5.5	6.0
18	5.2	6.9	5.2	5.5	8.5	11.2	9.2	6.0	5.6	5.6	5.6	5.7
19	5.3	7.0	5.2	5.4	8.4	10.9	8.8	6.0	5.9	6.1	5.5	6.1
20	5.4	7.0	5.3	5.7	8.0	10.0	8.7	6.3	6.0	6.5	5.5	5.4
21	5.5	6.8	5.3	5.6	7.6	8.9	11.9	6.8	5.8	7.3	5.4	5.2
22	4.9	6.8	5.4	5.6	7.3	8.4	9.4	7.3	5.7	6.3	5.4	5.5
23	6.3	6.8	5.5	6.2	7.2	8.4	10.8	6.5	5.6	5.9	5.4	5.4
24	6.9	6.7	5.6	11.6	7.0	8.3	10.4	6.3	5.6	5.7	5.4	5.5
25	6.0	[c]5.5	5.7	14.5	6.9	15.2	9.6	6.0	5.5	5.6	5.4	5.2
26	5.8	5.2	7.8	17.3	7.0	15.1	8.7	5.9	5.5	5.5	5.4	5.2
27	6.0	5.2	6.6	18.2	7.0	12.5	8.3	5.8	5.6	5.5	5.4	[a]5.0
28	6.6	5.2	5.8	18.0	7.5	11.9	7.9	5.8	5.5	5.6	5.4	[a]4.9
29	6.3	5.2	5.6	15.0	18.0	10.1	7.6	5.8	5.5	5.6	5.5	[a]5.6
30	6.2	.....	5.3	11.4	13.1	15.6	7.4	5.6	5.6	5.5	5.4	[a]5.8
31	6.1	.....	5.2	.....	12.0	.....	7.3	5.9	.....	5.5	.....	[a]5.7

[a] River frozen greater portion of January and February; also December 27 to 31. Gage read to water surface in hole cut in ice.
[b] Ice jam.
[c] River clear of ice.

Rating table for Blue River near Manhattan, Kans., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.60	680	6.40	1,540	8.20	2,850	12.50	7,940
4.70	710	6.50	1,600	8.40	3,020	13.00	8,690
4.80	740	6.60	1,660	8.60	3,190	13.50	9,440
4.90	770	6.70	1,725	8.80	3,370	14.00	10,200
5.00	800	6.80	1,790	9.00	3,550	14.50	10,990
5.10	840	6.90	1,855	9.20	3,740	15.00	11,800
5.20	880	7.00	1,920	9.40	3,940	15.50	12,640
5.30	930	7.10	1,990	9.60	4,150	16.00	13,490
5.40	980	7.20	2,060	9.80	4,370	16.50	14,340
5.50	1,030	7.30	2,130	10.00	4,600	17.00	15,190
5.60	1,080	7.40	2,200	10.20	4,830	17.50	16,040
5.70	1,135	7.50	2,275	10.40	5,070	18.00	16,900
5.80	1,190	7.60	2,350	10.60	5,310	19.00	18,720
5.90	1,245	7.70	2,430	10.80	5,560	20.00	20,700
6.00	1,300	7.80	2,510	11.00	5,810	21.00	22,700
6.10	1,360	7.90	2,595	11.50	6,470	22.00	24,700
6.20	1,420	8.00	2,680	12.00	7,190	23.00	26,750
6.30	1,480						

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is fairly well defined to gage height, 26 feet.

Estimated monthly discharge of Blue River near Manhattan, Kans., for 1904.

[Drainage area, 9,490 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January [a]						
February [a]						
March	2,510	800	996	61,240	0.105	0.121
April	17,250	980	3,778	224,800	.398	.444
May	16,900	1,855	4,155	255,500	.438	.505
June	15,190	2,680	6,337	377,100	.668	.745
July	26,340	2,130	6,991	429,900	.737	.850
August	2,130	1,080	1,508	92,720	.159	.183
September	1,660	1,030	1,160	69,020	.122	.136
October	2,935	1,030	1,310	80,550	.138	.159
November	1,080	980	1,010	60,100	.106	.118
December [b]	1,360	770	995	61,180	.105	.121
The period				1,712,000		

[a] Frozen during January and February.
[b] Frozen December 27-31. Rating table assumed to apply correctly.

MISCELLANEOUS MEASUREMENTS IN KANSAS RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Kansas River drainage basin in 1904:

Miscellaneous measurements of streams tributary to Republican River.

Date.	Hydrographer.	Stream.	Locality.	Area.	Mean velocity.	Discharge.
				Sq. ft.	*Ft. per sec.*	*Second-feet.*
June 4	J. C. Stevens	Blue River	Wymore, Nebr.	489	1.36	664
June 28	do	do	do	347	1.31	453
July 14	J. A. Green	do	Oak, Nebr			517
June 28	do	Frenchman River	Sec. 18, T. 16, R. 40	8	1.25	10
June 29	do	do	Champion, Nebr.	26	1.73	45
June 30	do	do	Palisade, Nebr.	60	4.00	240
July 11	do	Medicine creek	Curtis, Nebr			66
July 7	do	Millrace	Naponce, Nebr	17	1.41	24
July 7	do	Naponce	do	11	1.72	19
June 5	J. C. Stevens	Republican River	Warwick, Kans.	387	1.91	741
July 1	J. A. Green	do	McCook, Nebr	201	2.20	443
July 7	do	do	Naponce, Nebr	513	2.46	1,264
July 6	do	Sappa Creek	Stamford, Nebr.	38	.95	36
June 30	do	Stinking Water Creek	Palisade, Nebr.	56	1.41	79
June 30	do	do	do	49	1.29	63
July 7	do	Turkey Creek	Naponce, Nebr	11	.82	.9

MERAMEC RIVER DRAINAGE BASIN.

Meramec River rises in Dent County, Mo., flows northeast, and enters the Mississippi near St. Louis. This river drains a rugged, hilly, and comparatively thinly populated country. There are, however, numerous good sites for dams, and the United States Geological Survey is studying the river in connection with the possible water-power developments and for its possible use as a future water supply for the city of St. Louis.

The total drainage area of Meramec River is 3,619 square miles; at Eureka it is 3,497 square miles. The drainage area above Dry Fork is 340 square miles, while that of Dry Fork is 360 square miles.

MERAMEC RIVER NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located about 600 feet below the mouth of Spring Branch and about 1 mile from the post-road between Meramec, Mo., and St. James, Mo. The nearest railroad station is St. James, Mo., 7 miles northwest of the station. The gage is a 2 by 6 inch pine stick, 10 feet long, graduated to feet and tenths by means of brass-headed nails. The gage is driven into the bed of the river and is nailed at the top to a leaning tree. The gage is read once each day by C. C. Smallwood. The equipment by means of which discharge measurements are made consists of a cable, boat, and tagged wire. The initial point for soundings has been taken at the tree to which the cable is attached on the left bank. The channel is straight for about 300 feet above the station and for 2,000 feet below. The current velocity is sufficient for accurate measurement except at low stages, when it becomes sluggish. Both banks are low, and at high water the river spreads over wide flats. The bed of the stream is shifting. The bench mark is a point on a bowlder on the left bank at the foot of the cliff near the mouth of Spring Branch. Its elevation is 10.44 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Meramec River near Meramec, Mo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 27	F. W. Hanna	132	349	1.12	3.33	390
March 8	do	138	326	.99	3.22	322
April 13	do	145	579	1.01	4.05	[a] 585
June 14	Hanna and Murphy				3.10	[b] 281
July 27	F. W. Hanna				2.91	[b] 193
August 12	do				2.80	[b] 150
September 28	Hanna and Johnson				2.90	[b] 185

[a] 70 feet upstream. [b] Sum of both branches.

Mean daily gage height, in feet, of Meramec River near Meramec, Mo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	3.0	3.4	.....	4.2	3.4	4.4	2.9	2.9	3.0	2.75	2.75
2	2.5	3.0	3.4	.....	4.2	3.3	4.0	2.9	2.9	3.5	2.75	2.75
3	2.4	2.9	3.5	.....	4.1	3.4	3.8	2.9	2.9	3.4	2.75	2.75
4	2.4	2.8	3.3	.....	4.1	3.9	3.9	2.85	2.9	3.3	2.75	2.75
5	2.4	2.8	3.2	.....	4.2	4.8	3.9	2.85	2.9	3.1	2.75	2.75
6	2.4	2.8	3.5	.....	4.2	4.2	3.8	2.85	2.9	3.0	2.75	2.75
7	2.4	3.1	3.5	.....	4.2	3.9	3.6	2.8	2.8	3.0	2.75	2.75
8	2.4	2.9	3.3	.....	4.1	3.8	3.4	2.8	2.8	3.0	2.75	2.75
9	2.4	2.9	3.2	.....	4.4	3.5	3.4	2.8	2.8	2.9	2.75	2.75
10	2.4	2.8	3.1	.....	4.0	3.4	3.3	2.8	2.8	2.9	2.75	2.75
11	2.4	2.7	3.1	.....	3.9	3.4	3.3	2.8	2.8	2.9	2.75	2.75
12	2.4	2.7	3.2	.....	3.7	3.2	3.3	2.8	2.8	2.8	2.75	2.75
13	2.4	2.7	3.2	4.05	3.6	3.2	3.2	2.8	2.8	2.8	2.8	2.75
14	2.4	2.7	3.1	4.0	3.6	3.2	3.2	2.8	2.8	2.8	2.8	2.75
15	2.4	2.7	3.1	3.9	3.5	3.2	3.1	2.8	2.8	2.8	2.8	2.75
16	2.4	2.6	3.1	3.8	3.4	3.3	3.0	2.8	2.8	2.8	2.8	2.75
17	4.0	2.6	3.1	3.7	3.3	3.3	3.3	2.9	2.8	2.8	2.8	2.75
18	4.0	2.6	3.2	3.7	3.5	3.4	3.2	3.0	2.8	2.8	2.8	2.75
19	4.0	2.6	3.2	3.6	3.7	3.7	3.2	3.1	2.9	2.8	2.8	2.75
20	4.0	2.6	3.0	3.5	3.7	3.9	3.1	3.2	2.9	2.8	2.8	2.75
21	6.8	2.6	3.0	3.1	3.6	4.5	3.1	3.3	2.9	2.8	2.8	2.75
22	5.5	2.6	3.1	3.0	3.6	4.2	3.0	3.4	2.8	2.8	2.8	2.75
23	4.8	3.0	4.1	3.0	3.5	4.0	3.0	3.6	2.8	2.8	2.8	2.75
24	4.4	3.4	4.1	8.4	3.4	3.3	2.9	3.5	2.8	2.8	2.8	2.75
25	4.0	3.5	.....	8.0	3.4	3.3	2.9	3.2	2.9	2.8	2.8	2.75
26	3.4	3.4	.....	6.5	3.3	3.3	2.9	3.1	2.9	2.8	2.8	2.75
27	3.5	3.2	.....	6.1	3.6	6.1	2.9	3.1	2.9	2.8	2.8	2.75
28	3.2	3.1	.....	5.0	3.5	7.0	2.9	3.0	2.9	2.75	2.8	2.75
29	3.1	3.2	.....	4.9	3.4	5.3	2.9	3.0	2.9	2.75	2.8	2.75
30	3.0	.....	.....	4.7	3.9	4.9	2.9	2.9	2.9	2.75	2.75	2.75
31	3.0	.....	.....	.....	3.8	.....	2.9	2.9	.....	2.75	.....	2.75

MERAMEC RIVER NEAR EUREKA, MO.

This station was established August 26, 1903, by F. W. Hanna. It is located at the highway bridge on the road between Crescent, Mo., and Eureka, Mo., about 1½ miles from Eureka, 2 miles below the mouth of Big River, and 2 miles above the 'Frisco Railroad bridge. The standard boxed chain gage is attached to the floor of the bridge. The length of the chain from the end of the weight to the marker is 42.46 feet. The gage is read once each day by Rhoda Hilderbran. Discharge measurements are made from the bridge to which the gage is attached. This is a two-span Pratt truss highway bridge, with a length between abutments of 450 feet. The initial point for soundings is the inner face of the right abutment on the upstream side. The channel is straight for about 250 feet above and 1,000 feet below the station. The current is never sluggish. The right bank is high and rocky and not subject to overflow. It is wooded above the high-water line. The left bank is somewhat lower and is composed of alluvial soil, and it also is wooded above the high-water line. The bed of the stream is composed of coarse gravel and stones. There is but one channel, broken by the center pier of the bridge. Bench mark No. 1 is a notch cut into the high rock cliff just below the bridge. It is marked by a painted cross and the letters "U. S. G. S." Its elevation is 38.26 feet above gage datum. Bench mark No. 2 is a red mark on the top of the downstream guard rail, just above the gage box. Its elevation is 42.56 feet above gage datum. Bench mark No. 3 is a painted cross, surrounded by the letters "U. S. G. S." on the lower wing of the left abutment. Its elevation is 36.29 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Meramec River near Eureka, Mo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 28	F. W. Hanna	245	1,309	1.64	7.90	[a]2,151
March 9	do	170	554	2.93	4.30	1,620
April 14	do	215	924	4.01	6.20	3,703
April 28	do	444	8,154	4.59	24.95	37,470
April 29	do	294	2,389	4.48	11.60	10,700
June 15	Murphy and Hanna	163	529	3.01	4.37	1,605
July 26	F. W. Hanna	253	416	2.38	3.67	992
August 8	do	142	364	2.06	3.18	749
October 5	Johnson and Hanna	209	804	3.67	5.77	2,947
November 24	F. W. Hanna	143	313	1.89	3.08	591

[a] Backwater due to ice.

Mean daily gage height, in feet, of Meramec River near Eureka, Mo., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	.....	.....	11.70	7.90	9.30	9.20	3.50	5.00	4.20	3.20	3.00
2	3.00	.....	.....	12.10	7.30	7.40	9.10	3.40	4.40	8.00	3.20	3.00
3	2.90	.....	.....	10.50	6.70	6.70	6.20	3.30	4.20	8.10	3.20	3.00
4	2.90	.....	.....	8.70	6.30	10.00	7.50	3.40	3.90	6.80	3.10	3.00
5	2.90	.....	.....	7.30	6.50	11.80	8.20	4.50	3.80	5.80	3.10	3.00
6	2.80	.....	.....	6.70	6.40	11.20	8.10	3.50	3.70	5.30	3.10	3.00
7	2.80	.....	.....	6.40	7.30	9.10	7.90	3.50	3.60	5.00	3.10	3.00
8	2.80	.....	.....	6.40	6.90	7.00	8.70	3.40	3.50	4.70	3.10	3.00
9	2.90	.....	4.25	6.70	6.90	6.10	9.90	3.40	3.40	4.50	3.10	3.00
10	2.90	.....	4.00	10.60	6.80	5.50	13.20	3.30	3.30	4.30	3.20	3.00
11	2.90	.....	4.00	8.80	7.00	5.10	9.40	3.20	3.30	4.20	3.20	3.10
12	2.70	.....	3.90	7.50	6.40	4.80	8.00	3.20	3.20	4.00	3.20	3.10
13	2.70	.....	4.40	6.70	5.90	4.60	6.30	3.10	3.20	4.20	3.20	3.10
14	2.80	.....	4.30	6.20	5.50	4.50	5.50	3.10	3.30	3.90	3.20	3.10
15	2.70	.....	4.60	5.70	5.20	4.40	8.00	3.10	5.50	3.80	3.20	3.00
16	2.80	.....	4.50	5.50	5.10	4.50	4.50	4.70	4.50	3.70	3.20	3.10
17	2.70	.....	4.40	5.20	5.10	4.40	4.60	4.40	4.50	3.60	8.20	3.10
18	2.70	.....	4.70	5.10	5.00	4.90	4.40	4.10	4.10	3.60	3.10	3.10
19	2.60	.....	4.70	4.80	5.20	9.50	4.20	4.20	8.50	3.50	3.10	3.10
20	2.70	.....	5.30	5.00	5.80	9.70	4.10	5.10	11.20	3.40	3.10	3.10
21	[b]5.50	.....	5.20	5.40	5.40	10.80	4.20	4.80	9.50	3.40	3.10	3.10
22	8.90	.....	5.10	13.00	5.10	8.40	3.90	5.70	6.70	3.40	3.10	3.10
23	13.90	.....	5.20	11.40	4.90	6.90	3.80	4.90	5.40	3.30	3.10	3.10
24	14.40	.....	5.40	14.30	4.70	6.10	3.80	5.00	4.80	3.30	3.00	3.10
25	7.60	.....	7.90	20.80	4.60	5.80	3.70	4.90	5.90	3.30	3.00	3.10
26	5.80	.....	21.30	25.80	4.60	5.40	3.70	4.80	4.70	3.20	3.00	3.10
27	7.80	.....	35.20	28.70	4.50	5.10	3.60	4.50	7.20	3.20	3.00	3.20
28	7.90	.....	36.20	23.90	4.40	7.90	3.60	4.30	5.60	3.20	3.00	3.10
29	.....	.....	33.30	11.10	4.50	11.80	3.50	4.00	4.80	3.20	3.00	3.10
30	.....	.....	16.90	9.00	6.20	14.30	3.50	3.80	4.40	3.10	3.00	3.20
31	7.80	.....	9.80	.....	9.00	.....	3.50	3.70	.....	3.20	.....	3.10

[a] Ice conditions uncertain during January. Rating table applied as for open channel, January 1 to 20.

[b] Backwater from ice January 21 to 30.

Rating table for Meramec River near Eureka, Mo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	460	4.40	1,700	6.40	3,810	10.00	8,330
2.70	490	4.50	1,790	6.60	4,030	10.50	9,040
2.80	530	4.60	1,880	6.80	4,250	11.00	9,790
2.90	580	4.70	1,980	7.00	4,470	11.50	10,540
3.00	640	4.80	2,080	7.20	4,710	12.00	11,340
3.10	710	4.90	2,180	7.40	4,950	12.50	12,190
3.20	780	5.00	2,280	7.60	5,190	13.00	13,090
3.30	850	5.10	2,380	7.80	5,430	13.50	14,040
3.40	920	5.20	2,490	8.00	5,670	14.00	15,040
3.50	990	5.30	2,600	8.20	5,920	15.00	17,050
3.60	1,060	5.40	2,710	8.40	6,180	16.00	19,100
3.70	1,130	5.50	2,820	8.60	6,440	17.00	21,100
3.80	1,200	5.60	2,930	8.80	6,700	18.00	23,100
3.90	1,280	5.70	3,040	9.00	6,960	19.00	25,100
4.00	1,360	5.80	3,150	9.20	7,220	20.00	27,120
4.10	1,440	5.90	3,260	9.40	7,490		
4.20	1,520	6.00	3,370	9.60	7,770		
4.30	1,610	6.20	3,590	9.80	8,050		

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.8 feet and 6.2 feet. Two flood measurements at 11.6 and 25 feet gage height, respectively, define the curve above this limit. Above gage height 20 feet the rating curve is a tangent, the difference being 210 per tenth. The left bank overflows at the approximate gage height of 22.2 feet. It has been estimated that the overflow at 36.2 feet gage height was 7,000 second-feet or 50 second-feet per tenth gage height.

Estimated monthly discharge of Meramec River near Eureka, Mo., for 1904.

[Drainage area, 3,497 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1–20 [a]	710	460	544	21,580	0.156	0.116
March 9–31	68,060	1,280	12,570	573,400	3.59	3.07
April	48,560	2,080	10,520	626,000	3.01	3.36
May	6,960	1,700	3,294	202,500	.942	1.09
June	15,640	1,700	5,291	314,800	1.51	1.68
July	13,470	990	3,700	227,500	1.06	1.22
August	3,040	710	1,412	86,820	.404	.466
September	10,090	780	2,455	146,100	.702	.783
October	5,790	710	1,667	102,500	.477	.550
November	780	640	719	42,780	.206	.230
December	780	640	690	42,430	.197	.227
The period				2,386,000		

[a] Backwater from ice January 21 to 31.

MERAMEC SPRING NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located on Spring Branch 500 feet from the spring, at a foot-bridge. This point is about 1 mile from the mouth of Spring Branch and 2 miles above the mouth of Dry Fork. The gage is a 2 by 3 inch pine rod 10 feet long. It is read once each day by C. C. Smallwood. Discharge measurements are made from the footbridge. The initial point for soundings is at the tree at the end of the foot-bridge on the right bank. The channel is straight for 50 feet above and for 500 feet below the station. Both banks are of clay and gravel and are about 6 feet high. They will overflow only at unusual flood stages. The bed of the stream is composed of gravel with some bowlders and is clean. The water is very swift, making accurate gage readings very difficult. The bench mark is located on the left corner stone of the breast wheel of the tail race just below the old breast wheel and is designated by a cross on the top surface of the stone. Its elevation above the zero of the gage is 4.68 feet.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Meramec Spring near Meramec, Mo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 27	F. W. Hanna	28	48	4.02	0.75	193
March 8	do	28	43	4.28	.65	184
April 13	do	55	99	2.83	1.05	281
June 14	Murphy and Hanna	54	76	2.26	.60	172
July 27	F. W. Hanna	54	76	1.79	.48	136
August 12	do	56	70	1.64	.38	115
September 28	Hanna and Johnson	55	68	1.57	.37	107

NOTE.—The above measurements were made at different sections.

Mean daily gage height, in feet, of Meramec Spring near Meramec, Mo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.30	0.50	0.60	1.70	1.50	0.90	1.30	0.50	0.40	0.40	0.20	0.30
2	.30	.50	.60	1.60	1.30	.80	1.00	.50	.40	.50	.20	.30
3	.30	.50	.50	1.60	1.20	.80	1.00	.50	.40	.50	.20	.30
4	.25	.40	.50	1.50	1.10	1.10	1.00	.45	.40	.40	.20	.25
5	.25	.40	.50	1.40	1.10	1.40	1.00	.45	.40	.40	.20	.25
6	.25	.40	.70	1.40	1.20	1.20	.90	.45	.40	.40	.20	.25
7	.25	.70	.70	1.60	1.20	1.00	.90	.40	.40	.40	.20	.25
8	.25	.60	.70	1.80	1.00	.90	.80	.40	.40	.40	.20	.25
9	.25	.50	.60	1.60	1.20	.90	.80	.40	.40	.40	.20	.25
10	.20	.50	.60	1.40	1.10	.80	.70	.40	.40	.40	.20	.25
11	.20	.50	.60	1.20	1.00	.80	.70	.40	.40	.40	.20	.25
12	.20	.50	.60	1.10	1.00	.70	.70	.40	.40	.40	.20	.25
13	.20	.50	.60	1.00	.90	.70	.70	.40	.40	.40	.30	.25
14	.20	.40	.60	1.00	.90	.60	.60	.40	.40	.40	.30	.25
15	.20	.40	.50	.90	.80	.60	.60	.40	.40	.40	.30	.25
16	.20	.40	.50	.90	.90	.70	.65	.50	.40	.40	.30	.25
17	2.00	.35	.50	.80	.90	.80	.80	.50	.40	.40	.30	.25
18	2.00	.35	.60	1.20	.90	.90	.70	.50	.40	.40	.30	.25
19	2.00	.30	.60	1.10	.90	.80	.70	.60	.40	.40	.30	.25
20	2.00	.30	.60	.90	.90	.90	.70	.60	.40	.40	.30	.25
21	1.90	.90	.60	.90	.90	.90	.70	.60	.40	.35	.30	.25
22	1.70	.90	.70	.90	.80	.80	.70	.60	.40	.35	.30	.25
23	1.50	.80	.70	3.40	.80	.80	.70	.70	.40	.35	.30	.25
24	1.30	.80	.70	3.00	.80	.70	.50	.60	.40	.35	.30	.25
25	1.00	.80	7.00	2.80	.80	.70	.50	.60	.40	.35	.30	.25
26	.90	.80	7.05	2.40	.80	.90	.50	.60	.40	.30	.30	.25
27	.80	.70	5.40	2.10	.80	1.00	.50	.50	.40	.30	.30	.25
28	.70	.60	3.40	2.00	.80	2.20	.50	.50	.40	.30	.30	.25
29	.70	.60	2.80	1.90	.90	2.00	.50	.50	.40	.30	.30	.25
30	.60	.....	1.70	.....	1.20	1.80	.50	.50	.40	.20	.30	.25
31	.60	.....	1.70	.....	1.00	.....	.50	.40	.....	.20	.....	.25

Rating table for Meramec Spring near Meramec, Mo., from February 28, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	94	0.80	212	1.60	494	2.50	836
.35	104	.85	227	1.70	532	2.60	874
.40	114	.90	242	1.80	570	2.70	912
.45	125	.95	258	1.90	608	2.80	950
.50	136	1.00	275	2.00	646	2.90	988
.55	148	1.10	310	2.10	684	3.00	1,026
.60	160	1.20	346	2.20	722	3.10	1,064
.65	172	1.30	382	2.30	760	3.20	1,102
.70	185	1.40	418	2.40	798	3.30	1,140
.75	198	1.50	456				

The above table is applicable only for open-channel conditions. It is based upon 19 discharge measurements made during 1903 and 1904. It is well defined between gage heights 0.30 foot and 1.75 feet. The table has been extended beyond these limits. Above gage height 1.4 feet the rating curve is a tangent, the difference being 38 per tenth.

Estimated monthly discharge of Meramec Spring near Meramec, Mo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	646	76	236	14,510
February	242	94	150	8,628
March	2,565	136	454	27,920
April	1,178	212	473	28,140
May	456	212	273	16,790
June	722	160	273	16,240
July	382	136	194	11,930
August	185	114	135	8,301
September	114	114	114	6,783
October	136	76	109	6,702
November	94	76	86.8	5,165
December	94	85	85.9	5,282
The year	2,565	76	215	156,400

ARKANSAS RIVER DRAINAGE BASIN.

Arkansas River rises in the central part of Colorado, flows south for about 70 miles, then east for 50 miles, increased by many small mountain streams. At Canyon City, Colo., it emerges from the Rocky Mountain front and takes a general easterly direction across the great plains of Colorado, where most of the water is diverted for irrigation. It flows east across Kansas to the center of the State, thence southeast through Indian Territory and Arkansas into Mississippi River about 25 miles north of Greenville, Miss. Throughout the mountainous area above Canyon City the discharge increases, but as soon as the river emerges onto the Great Plains the water is gradually diverted by lines of canals, so that by the time the Kansas line is reached the river is usually dry during the summer. Among its tributaries, Neosho (called the Grand in Indian Territory) and Verdigris rivers drain southeastern Kansas and flow south in nearly parallel courses, joining the Arkansas about 3 miles apart, west of Talequah, Ind. T. Walnut River is a small tributary from the north, flowing into the Arkansas at Arkansas City, Kans. The North Fork of Canadian River rises in the northeastern part of New Mexico and flows east through Oklahoma and Indian Territory into Canadian River about 40 miles above its mouth.

ARKANSAS RIVER NEAR CANYON CITY, COLO.

This station is located at the suspension bridge at the Hot Springs Hotel. It is 1½ miles above the Strathmore Hotel and 1 mile above the State penitentiary, and a short distance below the mouth of Grape Creek at a point immediately below where the river leaves the mountains. Observations at this point were begun on April 17, 1889, the station being established here by Robert Robertson. The record has been maintained since that time, with occasional breaks due to absence or change of observer. The station is of special importance, being located at the mouth of the canyon and at a point practically above all of the irrigating ditches except the Canyon ditch (sometimes called the North Side ditch) and the South Canyon ditch (sometimes called the South Side ditch), both of which head above the station. During the irrigation season each of these ditches carries from 25 to 60 second feet of water according to the needs of the irrigators, and their discharge should be added to the discharge at the station in order to obtain the total run-off at the mouth of the canyon. No accurate records have been kept of the amount of water passing through these canals, although miscellaneous measurements have been made when measurements were made at the regular station. The estimated monthly discharges of the canyon do not include water taken out by these canals. This site

was used in 1888 for a gaging station by the State engineer of Colorado, but is favorable for obtaining only fairly accurate measurements.

The gage rod established by Mr. Robertson was of 2 by 6 inch timber, inclined, and attached to the crib of an old bridge on the south or right-hand side of the river, almost directly in front of the hotel. There were two bench marks: No. 1 on the top of a log of the crib—elevation, 10.01 feet above the datum; No. 2, in the cleft of a red bowlder at the foot of a charred stump 50 feet downstream and on the same side of the river—elevation, 9.60 feet.

On April 13, 1891, a third bench mark was established, this being a bedded rock 40 feet from the north end of the cable, toward Hot Springs Hotel, and 10 feet from the river bank. It is marked "B. M. No. 3, U. S. G. S.," and is 15.98 feet above the zero of the gage.

On October 4, 1895, it was found that the top of the gage had been broken off, necessitating its renewal for readings during high water. The channel was found to be filled with sand and gravel in front of the gage, requiring considerable work in order to make the water flow to the rod. It was decided, therefore, to put in a new gage where the stream could not deposit material. A point was chosen about 100 feet below the bridge, on the left bank, and a crib was built, anchored in place by rocks and bolts, the lower end of the gage being fastened to it. The upper end of the inclined portion was attached to a juniper tree. On December 27, 1895, the station was inspected, and it was found that readings had been made from the old rod, which, at the stage of water prevailing, recorded about 0.40 of a foot above the new rod on the opposite side of the river. When the water is high and extends with unbroken surface from bank to bank the readings are the same, but at low water the observations on the old rod are misleading, owing to the accumulation of sand and gravel in front of it.

On August 26, 1902, owing to the shifting of the channel, a new rod, consisting of 4 by 4 inch timber, was placed in an inclined position on the north or left bank of the river, at the site of the previous rod, just below the north end of the suspension bridge. The rod on this date read practically the same as the old rod.

A new gage was established September 2, 1903, by the State engineer. It is located on the right bank just below the bridge and consists of an inclined and a vertical section. The inclined section reads from zero to 7.3 feet. The vertical section reads from 7.3 to 12 feet. The present observer is Dr. J. L. Prentiss.

The measurements were at first made from a car suspended from a cable stretched across the river, the bridge from which measurements were originally made by the State engineer having been destroyed. Later a new suspension bridge was constructed in front of the hotel, necessitating the removal and replacement of the gage, and subsequent

measurements were made from this bridge, which, having a clear span, offers no obstruction to the current.

The initial point for soundings is the first post of the hand rail on the right bank. The channel is straight for 500 feet above and 300 feet below the station and has a width of about 135 feet. The current is very swift at high water and not too sluggish at low stages for accurate measurement. Both banks are high and rocky, and are not liable to overflow. The bed of the stream is composed of coarse gravel and small bowlders. It is not subject to change except on the right bank near the old gage, where a sand bar is formed at times of low water. The bed is rough, but is regular in shape. The bench mark in present use is a bedded bowlder 80 feet southeast of the south end of the suspension bridge, near the river bank. It is marked with a cross cut in the rock. Its elevation is 16.07 feet above the zero of the gage. This bench mark was checked December 16, 1903, and several times during 1904.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Arkansas River near Canyon City, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 1	R. I. Meeker	67	75	2.63	3.50	197
April 22	do	87	147	4.24	4.20	623
May 20	do	95	225	5.88	5.12	1,322
May 21 [a]	do	67	234	6.08	5.20	1,449
June 25	do	92	202	5.53	4.90	1,127
August 3	do	88	155	4.05	4.30	628
September 2	do	90	165	4.98	4.40	821

[a] Measured from Ninth Street Bridge.

Mean daily gage height, in feet, of Arkansas River near Canyon City, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.75	3.60	3.55	3.45	3.55	5.65	5.30	4.25	4.35	4.70	3.80	3.60
2	3.80	3.70	3.55	3.50	3.90	5.65	5.30	4.40	4.35	4.45	3.80	3.60
3	3.65	3.60	3.50	3.50	4.00	5.40	5.20	4.30	4.35	4.30	3.80	3.65
4	3.65	3.55	3.50	3.50	3.80	5.35	5.00	4.20	4.25	4.20	3.78	3.70
5	3.65	3.65	3.45	3.55	3.70	5.15	5.00	4.20	4.20	4.20	3.71	3.70
6	3.65	3.65	3.45	3.70	3.70	4.95	4.90	4.20	4.30	4.10	3.70	3.70
7	3.65	3.60	3.40	3.55	3.80	4.80	4.80	4.20	4.25	4.20	3.70	3.70
8	3.65	3.55	3.40	3.50	3.95	4.85	4.75	4.60	4.15	4.25	3.70	3.70
9	3.75	3.50	3.40	3.40	4.30	5.15	4.65	4.35	4.00	4.30	3.70	3.70
10	3.70	3.60	3.40	3.40	4.35	5.20	4.85	4.25	3.90	4.40	3.70	3.80
11	3.70	3.50	3.40	3.45	4.30	4.95	4.85	4.15	3.80	4.30	3.75	3.80
12	3.70	3.70	3.40	3.55	4.35	5.30	4.85	4.20	3.80	4.25	3.80	3.80
13	3.70	3.75	3.40	3.65	4.60	5.50	4.85	4.20	3.70	4.30	3.70	3.80
14	3.70	3.75	3.38	3.70	4.95	5.50	4.85	4.40	3.70	4.25	3.70	3.70
15	3.80	3.75	3.92	4.17	4.95	5.35	4.80	4.70	3.70	4.20	3.70	3.70
16	3.65	3.70	4.00	4.20	4.80	5.35	4.70	5.32	3.70	4.20	3.70	3.70
17	3.70	3.75	3.45	4.20	4.75	5.25	4.70	5.32	3.80	4.15	3.70	3.60
18	3.75	3.80	3.40	4.25	4.65	5.30	4.70	4.60	3.80	4.10	3.70	3.70
19	3.70	3.75	3.40	4.35	4.75	5.20	4.75	4.65	3.80	4.10	3.65	3.60
20	3.60	3.75	3.40	4.30	5.00	5.30	4.70	4.50	3.80	4.05	3.60	3.60
21	3.55	3.75	3.50	4.30	5.15	5.25	4.65	4.30	3.70	4.10	3.60	3.65
22	3.50	3.85	3.45	4.20	5.15	5.30	4.60	4.20	3.75	4.10	3.60	3.70
23	3.40	3.90	3.40	4.10	5.15	5.15	4.60	4.25	3.80	4.10	3.60	3.70
24	3.55	3.85	3.35	4.10	5.75	5.20	4.40	4.20	3.80	4.00	3.60	3.70
25	3.60	3.80	3.30	4.05	5.85	4.95	4.50	4.20	3.75	4.00	3.60	3.70
26	3.60	3.75	3.30	3.55	5.35	4.95	4.45	4.10	3.70	3.95	3.60	3.70
27	3.60	3.65	3.30	3.50	5.10	4.90	4.20	4.15	3.70	3.90	3.60	3.60
28	3.45	3.60	3.30	3.55	5.15	4.85	4.20	4.20	3.75	3.90	3.60	3.60
29	3.50	3.60	3.30	3.60	5.10	4.95	4.20	4.30	3.80	3.90	3.60	3.60
30	3.55	.....	3.30	3.60	5.15	5.20	4.30	4.40	4.90	3.80	3.60	3.70
31	3.55	.....	3.40	.....	5.65	.....	4.30	4.40	.....	3.80	.....	3.70

Rating table for Arkansas River near Canyon City, Colo., from January to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	119	3.90	406	4.60	880	5.30	1,490
3.35	136	4.00	465	4.70	960	5.40	1,590
3.40	155	4.10	529	4.80	1,040	5.50	1,690
3.45	175	4.20	593	4.90	1,122	5.60	1,795
3.50	197	4.30	660	5.00	1,210	5.70	1,905
3.60	243	4.40	730	5.10	1,300	5.80	2,015
3.70	295	4.50	802	5.20	1,392	5.90	2,125
3.80	349						

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1903 and 1904 and is well defined.

Estimated monthly discharge of Arkansas River near Canyon City, Colo., for 1904.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	349	155	264	16,230	0.086	0.099
February	406	197	290	16,680	.095	.102
March	465	119	176	10,820	.058	.067
April	695	155	355	21,120	.116	.129
May	2,070	220	989	60,810	.323	.372
June	1,850	1,040	1,396	83,070	.456	.509
July	1,490	593	975	59,950	.319	.368
August	1,510	529	726	44,640	.237	.273
September	1,122	295	444	26,420	.145	.162
October	960	349	563	34,620	.184	.212
November	349	243	285	16,960	.093	.104
December	349	243	287	17,650	.094	.108
The year	2,070	119	562	409,000	.184	2.50

ARKANSAS RIVER AT PUEBLO, COLO.

This station is an important one, being located near the head of the principal irrigated portion of the valley. Only one ditch of importance is taken out above it in the Pueblo district, although considerable water is used in the ditches in the neighborhood of Canyon City, which is in another water district. It is upon the gagings made at this point that the water superintendents and commissioners depend for distribution of water to ditches below.

The station was established in September, 1894, by A. P. Davis. Originally there were two gage rods. The main gage was located at the Santa Fe Avenue Bridge, and consisted of a vertical 6 by 6 inch timber and a 1 by 6 inch scale bolted to the abutment of the Denver and Rio Grande Railroad bridge on the left-hand side of the river, graduated to tenths of a foot. There was also a short vertical rod for extreme low water spiked to a pile about 20 feet out in the stream, reading the same as the main gage. The 12-foot mark of this gage was opposite the top of the large capstone. The rod at Victoria Avenue Bridge consisted of inclined 4 by 4 inch timbers fastened to posts set in the right bank of the stream, graduated to vertical tenths of a foot, the space between the marks being 0.242 of a foot. This rod was placed in June, 1895, for the purpose of noting the change in the slope of the water surface. The rods were read until July 10,

1898, when, on account of the shifting of the bed of the river, they were abandoned and a new gage was installed on the east side of the Main Street Bridge. From this bridge all the discharge measurements were made until the season of 1902.

Readings were made at Main Street Bridge until March 3, 1900, when, owing to the scouring of the channel, it became necessary to replace the gage by one about 60 feet below the south end of the Union Avenue Bridge. This gage was a 2 by 6 inch vertical timber, bolted, like the former rod, to the masonry wall and graduated to feet and tenths. On June 13, 1900, this rod was connected with a bench mark on the coping at the northwest corner of the Union Avenue Bridge, which was found to be 19.79 feet above the zero of the rod. In March, 1902, another rod exactly similar to the one last mentioned was bolted in a vertical position to the masonry wall on the right-hand side of the river about 30 feet above the south end of the Union Avenue Bridge. All gage heights up to July 14, 1902, were taken from the rod just below the Union Avenue Bridge. After July 14, 1902, the readings were taken from the rod above the bridge, the graduations on the former rod being too dim to be read at low water. A difference of 0.2 of a foot existed between the two rods when the new one was set, the new rod reading 0.2 of a foot higher than the old one. In all the discharge measurements made during 1902 the gage height was taken from the new rod above the Union Avenue Bridge. The gage is read twice each day by W. A. Stebbins. Discharge measurements are made from the Union Avenue Bridge, which is marked every 10 feet on the downstream side. The initial point for soundings is the edge of the masonry retaining wall on the right side of the channel at the southwest end of the bridge. The channel is straight for 500 feet above and 800 feet below the bridge, has a width of 150 feet, and is confined by high masonry walls. The bed is composed of sand and gravel, and there is little change in the bed of the channel, except that it fills during low water and scours out during high water. The flow of the stream is rapid, but not too swift for accurate measurements.

A bench mark was established March 31, 1904. It is the surface of the capstone of masonry wall to which gage is bolted and directly above rod. Its elevation is 18.13 feet above the zero of rod.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Arkansas River at Pueblo, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 22 [a]	R. I. Meeker	89	121	2.21	2.00	267
March 31 [a]	do	70	74	1.76	1.70	130
April 22 [b]	do	125	219	3.87	2.78	848
May 20 [b]	do	149	246	5.78	3.20	1,422
June 24 [b]	do	154	262	5.25	3.30	1,376
August 2 [b]	do	155	222	4.44	2.92	985
August 2 [b]	G. B. Monk	155	222	4.81	2.92	1,067
August 31 [b]	R. I. Meeker	144	152	4.25	2.62	646

[a] Measured at Victoria Avenue Bridge. [b] Measured at Main Street Bridge.

Mean daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.82	2.00	3.75	3.40	2.55	2.90	3.40	2.50	2.20
2	1.90	3.55	3.85	3.40	2.95	2.95	3.05	2.50	2.20
3	1.82	4.25	3.65	3.10	2.70	3.05	2.85	2.45	2.20
4	1.85	2.55	3.60	3.05	2.65	2.65	2.85	2.35	2.25
5	1.88	2.20	3.05	3.05	2.50	2.60	2.75	2.35	2.25
6	1.88	2.50	3.10	3.05	2.45	2.60	2.70	2.35	2.25
7	1.98	2.65	2.90	2.80	2.45	2.75	2.65	2.35	2.25
8	1.88	2.75	3.45	3.05	2.80	2.70	2.80	2.35	2.25
9	1.78	2.90	4.10	2.65	2.45	2.60	2.90	2.35	2.30
10	1.65	2.95	3.50	2.85	2.35	2.45	2.80	2.35	2.30
11	1.60	3.05	3.20	2.90	2.45	2.45	2.85	2.35	2.35
12	1.65	2.95	3.50	2.80	2.45	2.45	2.85	2.35	2.35
13	1.75	3.05	3.35	2.80	2.45	2.35	2.85	2.45	2.35
14	1.88	3.10	4.05	2.75	3.00	2.35	2.85	2.40	2.30
15	2.18	3.40	4.75	2.78	3.60	2.25	2.80	2.35	2.30
16	2.55	3.05	4.40	2.75	2.85	2.25	2.75	2.30	2.30
17	2.50	2.95	4.00	2.70	3.10	2.15	2.75	2.30	2.30
18	2.55	2.92	3.80	2.75	3.55	2.25	2.75	2.35	2.30
19	2.50	2.92	3.60	3.15	3.50	2.25	2.65	2.25	2.30
20	2.65	3.35	3.40	2.75	3.10	2.25	2.65	2.35	2.30
21	2.60	3.32	4.10	2.85	2.70	2.25	2.65	2.25	2.30
22	2.60	3.45	3.55	2.80	2.65	2.25	2.65	2.25	2.30
23	2.52	3.28	3.60	2.85	2.75	2.25	2.65	2.25	2.30
24	2.52	3.78	3.25	4.25	2.65	2.25	2.60	2.25	2.30
25	2.50	4.05	3.25	3.15	2.75	2.25	2.60	2.25	2.30
26	2.40	3.75	3.15	2.55	2.75	2.25	2.60	2.20	2.30
27	1.95	3.45	3.15	2.45	2.85	2.30	2.60	2.20	2.30
28	1.90	3.40	3.10	2.55	2.70	2.30	2.60	2.20	2.25
29	1.80	3.20	3.05	2.55	2.75	2.45	2.55	2.20	a4.15
30	1.95	3.15	3.05	2.55	3.25	3.05	2.55	2.20	4.45
31	.....	3.50	.....	2.70	2.85	.....	2.50	.....	4.45

[a] Ice jam below station.

Rating table for Arkansas River at Pueblo, Colo., from April 1, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	95	2.10	315	3.00	1,060	3.90	2,150
1.65	110	2.20	375	3.10	1,170	4.00	2,280
1.70	130	2.30	440	3.20	1,280	4.10	2,410
1.75	150	2.40	510	3.30	1,400	4.20	2,540
1.80	170	2.50	590	3.40	1,520	4.30	2,680
1.85	190	2.60	670	3.50	1,640	4.40	2,820
1.90	215	2.70	760	3.60	1,760	4.50	2,960
1.95	240	2.80	860	3.70	1,890	4.60	3,100
2.00	265	2.90	960	3.80	2,020	4.70	3,240

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904 and one high-water measurement made in 1903. It is well defined between gage heights 1.60 feet and 3.30 feet.

Estimated monthly discharge of Arkansas River at Pueblo, Colo., for 1904.

[Drainage area, 4,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	715	95	350	20,830	0.076	0.085
May	2,610	265	1,260	77,470	.274	.316
June	3,310	960	1,711	101,800	.372	.415
July	2,610	550	976	60,010	.212	.244
August	1,760	475	874	53,740	.190	.219
September	1,115	345	578	34,390	.126	.141
October	1,520	590	810	49,800	.176	.203
November	590	375	456	27,130	.099	.110
December [a]	475	375	424	26,070	.092	.106
The period				451,200		

[a] Discharge estimated December 29–31, as river was gorged with ice.

ARKANSAS RIVER NEAR SYRACUSE, KANS.

This station, established August 21, 1902, by W. G. Russell, is located on the highway bridge 1 mile south of Syracuse, Kans. The gage is a plain staff graduated to feet and tenths, and fastened to the east pile of the bent 283 feet south of the north end of the bridge. On November 12, 1904, this gage was moved by W. G. Russell to the down-stream pile of bent, 158 feet from the initial point as the water had left the gage. The initial point for soundings is on the left bank. The channel above and below the station is straight and the water is sluggish. The right bank is low and liable to overflow; the left bank is high, and the bed of the stream is sandy and shifting. The bench mark is on the top of the east end of the first sill at the north end of the bridge. Its elevation is 11.52 feet above the zero of the gage. The gage is read daily by M. Adaline Stewart.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River near Syracuse, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 7	W. G. Russell	232	368	2.33	3.60	858
May 21	do	57	39	.97	1.90	38
May 22	do	524	1,064	5.25	4.70	5,582
May 23	do	581	1,643	4.27	5.15	7,009
May 23	do	575	1,435	4.01	4.80	5,750
June 15	do	.....	2,060	4.51	5.50	9,291
November 12	do	85	85	2.19	1.40	186

Mean daily gage height, in feet, of Arkansas River near Syracuse, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.10	2.40	1.90	1.90	1.70	3.00	2.90	3.75	2.90	6.75	2.40	1.20
2	2.10	2.40	1.90	1.90	1.80	2.80	2.80	4.65	3.10	7.00	2.20	1.20
3	2.10	2.40	1.90	1.90	1.80	2.60	2.70	4.40	3.00	5.70	2.20	1.20
4	2.20	2.40	1.90	1.90	6.20	2.60	2.70	3.50	4.50	4.70	2.10	1.20
5	2.40	2.40	1.90	1.90	4.50	2.50	2.80	3.40	4.00	3.80	2.00	1.20
6	2.40	2.60	1.90	1.80	3.90	2.50	3.50	3.20	3.50	3.70	1.80	1.20
7	2.40	2.50	1.90	1.80	3.80	3.10	3.50	4.15	3.10	3.70	1.70	1.20
8	2.40	2.50	1.90	1.80	3.60	3.40	3.10	4.30	2.90	3.50	1.60	1.40
9	2.40	2.50	1.90	1.90	3.50	3.40	3.40	4.10	2.80	3.50	1.60	1.40
10	2.40	2.60	1.90	1.90	3.20	6.15	3.80	3.50	2.70	3.50	1.50	1.80
11	2.40	2.60	1.90	1.80	2.50	6.00	3.80	2.90	2.50	3.40	1.50	1.90
12	2.50	2.70	1.90	1.80	2.30	5.00	4.60	3.10	2.50	3.40	1.40	1.80
13	2.50	2.70	1.90	1.80	2.30	5.50	3.90	3.40	2.40	3.40	1.40	1.50
14	2.50	2.70	1.90	1.80	2.30	6.20	3.50	3.40	2.40	3.40	1.30	1.40
15	2.50	2.60	1.90	1.70	2.30	5.50	3.30	3.30	2.40	3.40	1.30	2.50
16	2.60	2.60	1.90	1.70	2.30	4.50	2.80	3.20	2.30	3.30	1.30	2.50
17	2.60	2.50	1.90	1.70	2.30	4.20	2.80	3.20	2.30	3.30	1.30	2.50
18	2.60	2.40	1.90	1.70	2.30	4.00	2.80	3.00	2.30	3.30	1.30	2.30
19	2.60	2.40	1.90	1.70	1.90	3.70	2.60	5.75	2.20	3.10	1.30	2.00
20	2.50	2.40	1.90	1.70	1.90	3.60	2.50	5.25	2.20	3.10	1.30	1.50
21	2.40	2.40	1.90	1.70	1.85	3.50	2.50	4.60	2.20	3.10	1.30	1.50
22	2.40	2.30	1.90	1.70	5.00	5.75	2.40	3.50	2.10	3.00	1.20	1.50
23	2.40	2.30	1.80	1.70	4.95	5.00	2.80	3.30	2.10	3.00	1.20	1.60
24	2.30	2.00	1.80	1.70	4.30	3.80	2.80	3.20	2.10	3.00	1.20	1.60
25	2.30	2.00	1.80	1.70	4.10	3.50	2.80	3.10	2.10	2.80	1.20	1.50
26	2.40	2.00	1.80	1.70	3.80	3.40	3.90	2.90	2.10	2.80	1.20	1.50
27	2.40	1.90	1.80	1.70	3.50	3.40	3.90	2.80	2.10	2.70	1.20	1.30
28	2.50	1.90	1.80	1.70	3.45	3.20	3.90	2.90	2.10	2.70	1.20	1.30
29	2.40	1.90	1.80	1.70	3.30	3.20	3.40	2.70	2.20	2.50	1.20	1.30
30	2.40	.....	1.80	1.75	3.10	3.00	3.10	2.90	2.30	2.50	1.20	1.20
31	2.40	.....	1.90	.....	3.00	.....	2.80	2.70	.....	2.50	.....	1.20

ARKANSAS RIVER NEAR DODGE, KANS.

This station was established November 28, 1902, by W. G. Russell, and is located one-fourth mile south of Dodge, on the highway bridge. The gage is a plain staff graduated to feet and tenths and nailed to the upstream pile of the twelfth bent at the north end of the bridge. After the flood of October 1–3, 1904, the water left this gage and it was moved to the upstream pile of a bent 337 feet from the north end of the bridge and tested with a Wye level October 19, 1904, and found correct. The initial point for soundings is on the left bank. The channel both above and below the station is straight for about 100 feet. Both banks are low and liable to overflow. The bed of the stream is sandy and shifting. The gage is read once each day by Alexander Alter. Bench mark No. 1 is the top of the east end of the cap at the north end of the bridge; elevation 100.00 feet. Bench mark No. 2 is the top of the east end of the cap at the abutment of the south end of the bridge; elevation, 100.27 feet.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River near Dodge, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 26	W. G. Russell	16	4	1.00	1.00	4
May 5	do	425	826	3.77	3.10	3,110
May 6	do	415	699	2.78	2.80	1,947
May 24	do	415	750	4.04	3.05	3,031
May 24	do	426	905	3.91	3.25	3,541
May 25	do	416	792	3.11	3.00	2,461
June 14	do	556	1,165	3.36	3.55	3,908
June 14	do	558	1,864	4.35	4.60	8,102
August 20	do	185	78	1.59	1.65	124
August 21	do	433	662	3.06	3.00	2,029
August 22	do	465	982	3.38	3.30	3,323
August 23	do	430	625	2.78	2.90	1,739
September 22	do	87	27	.85	1.20	23
October 2	do	.....	2,918	4.42	6.25	12,890
October 19	do	335	371	1.95	1.90	723
November 10	do	.....	193	1.81	1.30	350

Mean daily gage height, in feet, of Arkansas River near Dodge, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.20	1.30	1.20	1.00	1.00	2.00	2.00	1.80	1.60	1.50	1.40	1.10
2	1.20	1.30	1.20	1.00	1.10	2.00	1.95	1.70	1.60	6.75	1.40	1.10
3	1.10	1.30	1.20	1.00	1.40	2.00	1.85	1.55	1.60	6.25	1.40	1.10
4	1.10	1.30	1.20	1.00	1.50	1.85	1.80	2.40	1.60	4.50	1.40	1.40
5	1.10	1.30	1.20	1.00	2.45	1.70	1.80	2.25	1.70	3.90	1.40	1.50
6	1.10	1.30	1.20	1.00	3.00	1.60	1.70	1.80	1.80	3.40	1.40	1.45
7	1.10	1.30	1.20	1.00	2.55	1.60	1.70	1.65	1.90	2.85	1.40	1.40
8	1.10	1.30	1.20	1.00	2.25	1.50	1.80	1.70	2.05	2.40	1.30	1.30
9	1.10	1.30	1.10	1.00	2.05	1.50	1.90	2.45	1.95	2.25	1.30	1.30
10	1.10	1.30	1.10	1.00	2.00	1.50	1.85	2.30	1.75	2.20	1.30	1.30
11	1.20	1.20	1.10	1.00	1.80	4.75	1.80	2.00	1.60	2.10	1.30	1.30
12	1.20	1.20	1.10	1.00	1.80	4.50	2.00	1.90	1.60	1.95	1.30	1.30
13	1.20	1.20	1.00	.90	1.70	4.45	2.10	1.80	1.60	1.85	1.30	1.40
14	1.20	1.30	1.00	.90	1.70	3.55	2.00	1.80	1.50	2.00	1.25	1.40
15	1.20	1.30	1 00	.90	1.60	4.20	2.00	1.70	1.50	2.00	1.20	1.40
16	1.10	1.30	1.00	.90	1.50	3.80	2.00	1.60	1.40	1.95	1.20	1.40
17	1.10	1.40	1.00	.90	1.50	3.50	1.85	1.50	1.40	1.85	1.10	1.40
18	1.10	1.40	1.00	.90	1.40	3.10	1.70	1.60	1.30	1.85	1.10	1.40
19	1.10	1.40	1.00	.90	1.30	2.75	1.60	1.65	1.30	1.90	1.10	1.40
20	1.10	1.40	1.00	.90	1.30	2.60	1.60	1.55	1.20	1.90	1.10	1.40
21	1.10	1.40	1.00	.90	1.30	2.50	1.70	3.10	1.20	1.80	1.10	1.40
22	1.10	1.40	1.00	.90	1.30	2.55	1.70	3.20	1.20	1.65	1.10	1.40
23	1.10	1.40	1.00	1.10	1.30	4.65	1.60	2.80	1.15	1.60	1.10	1.45
24	1.10	1.30	1.00	1.00	3.30	3.50	1.50	2.55	1.10	1.60	1.10	1.50
25	1.20	1.30	1.00	1.00	2.95	2.90	1.50	2.40	1.10	1.50	1.10	1.50
26	1.20	1.30	1.00	1.00	2.50	2.60	1.50	2.10	1.10	1.50	1.10	1.50
27	1.20	1.30	1.00	1.00	2.15	2.50	1.40	2.00	1.10	1.50	1.10	1.50
28	1.20	1.30	1.00	1.00	1.60	2.25	1.30	1.90	1.10	1.50	1.10	1.50
29	1.30	1.30	1.00	1.00	1.55	2.05	1.55	1.75	1.20	1.50	1.10	1.50
30	1.30	.....	1.00	1.00	1.80	2.00	2.00	2.05	1.50	1.50	1.10	1.50
31	1.30	.....	1.00	.....	1.70	.....	1.90	1.75	.....	1.50	.....	1.50

Rating table for Arkansas River near Dodge, Kans., from January 1 to September 17, 1904.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	3	1.90	375	2.90	2,200	3.90	5,310
1.00	4	2.00	490	3.00	2,470	4.00	5,680
1.10	8	2.10	615	3.10	2,750	4.10	6,060
1.20	14	2.20	760	3.20	3,035	4.20	6,450
1.30	28	2.30	925	3.30	3,330	4.30	6,850
1.40	40	2.40	1,100	3.40	3,635	4.40	7,260
1.50	70	2.50	1,285	3.50	3,950	4.50	7,680
1.60	115	2.60	1,490	3.60	4,275	4.60	8,110
1.70	180	2.70	1,710	3.70	4,610	4.70	8,550
1.80	270	2.80	1,945	3.80	4,955		

[a] Table not used in making the daily estimates on May 5 and 24, August 20 and 21, and August 23 to 26.

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904. It is not well defined, owing to the shifting character of the channel.

Estimated monthly discharge of Arkansas River near Dodge, Kans., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January [a]	28	8	12.1	744
February	40	14	29.4	1,691
March	14	4	7.10	437
April	8	3	3.80	226
May [b]	3,730	4	559	34,370
June	8,775	70	2,456	146,100
July	615	28	271	16,660
August [b]	3,035	70	598	37,770
September [b]	550	12	113	6,724
October [b]	14,800	85	1,986	122,100
November [b]	395	270	320	19,040
December [a b]	450	270	393	24,160
The year	14,800	3	562	409,000

[a] River frozen greater portion of January and December. Estimates made same as for open channel.
[b] Discharge for May 5 and 24, August 20, 21, and 23 to 26, September 18 to December 31, estimated indirectly.

ARKANSAS RIVER AT HUTCHINSON, KANS.

This station was established May 13, 1895, and is located at the wagon bridge at the south end of Main street. The gage consists of a pine timber, 2 by 6 inches by 9 feet, graduated to feet and tenths, and fastened to the downstream pier of fourth set from north end. Bench mark No. 1 is the upper crosspiece of the pier guard. Its elevation is 8.35 feet above the zero of the gage. Bench mark No. 2 is the top of the iron doorsill of the first brick building next to the river. Its elevation is 8.12 feet above gage datum. The channel is straight for some distance above and below the bridge and has a width of 1,020 feet, broken by 11 steel piers. The bed is sandy and very shifting, necessitating frequent discharge measurements and soundings. At low water the stream subdivides into a number of small channels. Measurements of discharge are made from the bridge at high water, and at low water they can be made by wading. The observer is George E. Dixon.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River at Hutchinson, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 25	W. G. Russell	126	44	1.48	1.30	65
May 9	do	542	653	2.06	2.71	1,344
May 10	do	426	454	2.44	2.50	1,117
May 27	do	244	110	2.18	1.70	240
May 27	do	426	477	2.52	2.47	1,202
May 28	do	423	374	2.49	2.36	923
June 16	do	655	1,292	3.42	3.92	4,419
June 17	do	744	1,596	3.22	4.32	5,151
August 23	do	301	270	2.04	2.20	550
August 24	do	524	852	2.51	3.12	2,140
August 25	do	504	672	2.21	2.80	1,488
October 3	do	254	184	2.04	1.95	376
October 4	do	.....	1,838	4.82	4.65	8,867
October 5	do	892	2,073	4.54	4.95	9,419

Mean daily gage height, in feet, of Arkansas River at Hutchinson, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.20	1.50	1.45	1.30	1.50	2.25	3.30	2.25	2.20	2.02	2.20	1.80
2	1.15	1.50	1.45	1.30	1.50	2.25	3.38	2.15	2.20	1.95	2.15	1.80
3	1.25	1.50	1.45	1.35	1.50	2.37	3.22	2.20	2.12	3.22	2.15	1.75
4	1.25	1.55	1.45	1.35	1.57	3.25	3.38	2.25	2.05	4.80	2.10	1.70
5	1.30	1.55	1.45	1.32	1.57	3.40	3.92	2.25	1.85	3.92	2.10	1.65
6	1.30	1.55	1.45	1.30	1.60	3.05	4.85	2.25	1.95	4.32	2.10	1.60
7	1.35	1.55	1.45	1.35	1.50	2.65	4.68	2.18	1.90	3.90	2.05	1.60
8	1.35	1.55	1.45	1.35	1.75	2.40	4.20	2.05	1.90	3.65	2.05	1.55
9	1.35	1.55	1.40	1.35	2.68	2.17	3.80	2.32	1.60	3.50	2.05	1.50
10	1.30	1.55	1.40	1.40	2.45	2.10	3.40	2.30	1.85	3.25	2.00	1.50
11	1.35	1.55	1.40	1.40	2.40	2.00	2.97	2.25	2.08	3.00	2.10	1.45
12	1.35	1.55	1.40	1.35	2.40	2.00	2.75	2.20	2.10	2.92	2.10	1.40
13	1.35	1.55	1.40	1.35	2.15	3.20	2.70	2.12	1.98	2.90	2.05	1.40
14	1.40	1.55	1.40	1.35	2.10	4.02	2.70	2.45	1.90	2.80	2.05	1.40
15	1.40	1.55	1.40	1.35	2.10	3.82	2.60	2.25	1.80	2.70	2.05	1.40
16	1.45	1.55	1.35	1.35	2.05	4.15	2.60	2.30	1.60	2.65	2.05	1.45
17	1.45	1.50	1.35	1.35	2.00	4.35	2.55	2.30	1.70	2.65	2.05	1.50
18	1.45	1.50	1.35	1.35	2.00	4.30	2.48	2.30	1.65	2.60	2.05	1.55
19	1.45	1.50	1.30	1.35	2.00	4.00	2.45	2.25	1.60	2.60	2.00	1.55
20	1.40	1.50	1.40	1.35	2.00	3.65	2.45	2.28	1.50	2.50	1.95	1.55
21	1.40	1.50	1.25	1.35	2.00	3.48	2.40	2.25	1.50	2.50	1.95	1.55
22	1.45	1.50	1.25	1.35	1.85	3.35	2.35	2.22	1.50	2.45	1.90	1.55
23	1.45	1.45	1.25	1.45	1.85	3.10	2.30	2.20	1.50	2.40	1.90	1.62
24	1.45	1.45	1.25	1.50	1.80	2.85	2.30	2.58	1.50	2.40	1.85	2.00
25	1.45	1.45	1.30	1.55	1.70	3.60	2.65	2.75	1.60	2.35	1.80	2.00
26	1.50	1.45	1.40	1.55	1.62	4.00	2.60	2.58	1.60	2.30	1.80	2.05
27	1.50	1.45	1.40	1.50	2.67	3.85	2.48	2.50	1.50	2.25	1.85	2.00
28	1.50	1.45	1.40	1.50	2.35	3.45	2.48	2.45	1.40	2.25	1.85	2.00
29	1.55	1.45	1.32	1.45	2.37	3.30	2.45	2.35	1.40	2.20	1.85	2.00
30	1.50	.....	1.30	1.48	2.30	3.42	2.35	2.35	1.45	2.20	1.85	2.00
31	1.50	.....	1.30	.....	2.25	.....	2.30	2.30	.....	2.20	.....	2.00

Rating table for Arkansas River at Hutchinson, Kans., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	50	2.20	630	3.20	2,340	4.20	5,360
1.30	65	2.30	740	3.30	2,590	4.30	5,730
1.40	95	2.40	860	3.40	2,850	4.40	6,110
1.50	135	2.50	995	3.50	3,120	4.50	6,500
1.60	180	2.60	1,145	3.60	3,400	4.60	6,900
1.70	230	2.70	1,310	3.70	3,690	4.70	7,310
1.80	290	2.80	1,490	3.80	3,990	4.80	7,730
1.90	360	2.90	1,680	3.90	4,310	4.90	8,150
2.00	440	3.00	1,885	4.00	4,650	5.00	8,580
2.10	530	3.10	2,105	4.10	5,000		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904, and is well defined.

Estimated monthly discharge of Arkansas River at Hutchinson, Kans., for 1904.

[Drainage area, 34,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	157	45	97.3	5,983	0.0029	0.0033
February	157	115	140	8,053	.0041	.0044
March	115	57	89.2	5,485	.0026	.0030
April	157	65	93.7	5,576	.0028	.0031
May	1,277	135	491	30,190	.014	.016
June	5,920	440	2,663	158,500	.078	.087
July	7,940	740	2,073	127,500	.061	.070
August	1,400	485	758	46,610	.022	.025
September	630	95	288	17,140	.0085	.0095
October	7,730	400	1,834	112,800	.054	.062
November	630	290	447	26,600	.013	.014
December	485	95	237	14,570	.0070	.0081
The year	7,940	45	768	559,000	.022	.305

ARKANSAS RIVER NEAR ARKANSAS CITY, KANS.

This station was established September 23, 1902, by W. G. Russell. It is located on Chestnut Avenue Bridge, one-half mile west of Arkansas City, Kans. The gage is a painted staff graduated to feet and tenths, spiked to the west side of the south pile of the second bent on Chestnut avenue. The bench mark is the top of the cap on the pile which carries the gage. Its elevation is 17.20 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the south pile of the bent of the east abutment. Elevation 11.97 feet. The initial point for soundings is on the left bank. The channel is straight for about 200 feet both above and below the station and has a width of 550 feet, broken by 36 pile piers. Both banks are low and liable to overflow. The bed of the river is sandy and shifting. The current is moderately rapid. The gage is reads daily by A. E. Burton.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River near Arkansas City, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 24	W. G. Russell	158	175	1.55	3.50	272
May 12[a]	Russell and Meyers	430	1,033	2.11	5.56	[b] 2,176
May 12	W. G. Russell	383	856	2.23	5.56	1,909
May 13	Russell and Meyers	430	990	2.06	5.45	[b] 2,034
May 13[a]	W. G. Russell	382	852	2.42	5.45	2,066
June 5	do	[b] 560	6,930	3.41	13.25	23,660
June 6	do	554	4,547	2.85	10.70	12,940
June 18	do	405	2,066	3.04	7.67	6,276
June 19	do	.....	1,873	2.76	7.40	5,167
July 10	E. C. Murphy	[c] 2,287	11,290	3.57	15.20	40,310
July 23	Murphy and Russell	288	1,177	2.35	5.55	2,763
August 26	W. G. Russell	198	504	2.19	3.80	1,104
October 6	do	.....	1,399	4.33	7.30	6,053

[a] At Colorado gage one-half mile below. [b] Some overflow. [c] Flood estimate.

Mean daily gage height, in feet, of Arkansas River near Arkansas City, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.80	3.50	3.80	3.80	4.20	6.20	7.00	4.80	3.70	3.30	3.50	3.20
2	3.70	3.50	3.90	3.60	4.10	8.10	6.90	4.70	3.60	3.30	3.40	3.10
3	3.70	3.60	3.90	3.80	4.30	11.20	7.50	4.60	3.40	3.30	3.40	3.00
4	3.80	3.60	3.70	3.90	4.20	12.90	8.70	4.40	3.40	3.30	3.40	3.00
5	3.70	3.60	3.60	3.60	4.30	13.30	9.50	4.20	3.50	3.30	3.30	3.00
6	3.70	3.50	3.70	3.70	4.50	10.80	10.50	4.30	3.60	7.30	3.40	2.90
7	3.60	3.70	3.70	3.70	4.60	8.90	13.30	4.50	3.50	6.90	3.40	2.90
8	3.60	3.70	3.60	3.80	4.70	8.10	14.20	4.60	3.40	6.50	3.40	2.80
9	3.40	3.90	3.60	3.70	4.80	8.20	14.95	4.50	3.40	6.20	3.30	2.90
10	3.50	3.90	3.70	3.70	5.60	9.10	15.20	4.50	3.30	5.80	3.30	3.00
11	3.40	3.80	3.80	3.80	6.20	7.60	14.50	4.40	3.40	5.30	3.40	3.10
12	3.30	3.70	3.90	3.90	5.60	7.70	13.80	4.20	3.40	5.10	3.30	3.10
13	3.10	3.70	3.80	3.90	5.45	7.60	12.50	4.00	3.40	4.90	3.60	3.00
14	3.20	3.80	3.80	3.80	5.10	7.50	11.80	4.10	3.30	4.60	3.50	2.90
15	3.30	3.90	3.70	3.80	4.90	7.60	9.20	4.20	3.30	4.40	3.60	2.90
16	3.30	3.80	3.70	3.70	4.80	7.80	8.10	4.40	3.30	4.10	3.50	3.00
17	3.60	3.80	3.70	3.60	4.90	7.40	7.20	4.30	3.30	4.00	3.40	3.00
18	3.70	3.70	3.60	3.60	4.80	7.80	7.00	4.20	3.40	3.80	3.40	3.10
19	3.80	3.70	3.60	3.70	4.70	7.40	6.40	4.20	3.40	3.90	3.30	3.10
20	3.70	3.60	3.70	3.60	4.60	7.30	6.30	4.10	3.30	3.80	3.30	3.20
21	3.70	3.70	3.80	3.50	4.50	7.00	6.10	4.10	3.30	3.80	3.30	3.30
22	3.80	3.80	3.80	3.50	4.90	6.60	5.80	4.00	3.20	3.90	3.40	3.30
23	3.80	4.10	3.90	3.40	5.00	6.40	5.50	4.00	3.30	3.90	3.40	3.20
24	3.70	4.20	3.50	3.60	4.90	5.90	5.70	4.10	3.30	3.80	3.30	3.30
25	3.70	4.30	3.60	3.90	4.70	5.80	5.40	4.10	3.30	3.80	3.40	3.30
26	3.60	4.20	3.70	5.60	4.60	6.00	5.20	3.80	3.20	3.70	3.30	3.30
27	3.40	4.10	4.40	5.30	4.00	6.60	5.20	4.20	3.20	3.60	3.30	3.40
28	3.40	3.80	4.70	4.80	4.20	7.20	5.10	4.10	3.30	3.60	3.30	3.40
29	3.40	3.70	4.90	4.60	5.30	7.00	5.00	4.00	3.40	3.50	3.30	3.30
30	3.40	.....	5.80	4.30	5.50	7.10	5.00	4.00	3.30	3.50	3.20	3.20
31	3.40	.....	3.90	.....	6.10	.....	4.90	3.80	.....	3.50	.....	3.10

Rating table for Arkansas River near Arkansas City, Kans., from January 1 to June 1, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	165	3.90	453	4.70	1,096	5.50	2,080
3.20	185	4.00	510	4.80	1,202	5.60	2,225
3.30	209	4.10	574	4.90	1,314	5.70	2,375
3.40	238	4.20	644	5.00	1,430	5.80	2,530
3.50	272	4.30	721	5.10	1,550	5.90	2,690
3.60	310	4.40	806	5.20	1,675	6.00	2,855
3.70	353	4.50	898	5.30	1,805	6.10	3,025
3.80	401	4.60	995	5.40	1,940	6.20	3,200

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904 and the general form of the curve for 1903. It is fairly well defined.

Rating table for Arkansas River near Arkansas City, Kans., from June 2 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	590	4.40	1,560	6.00	3,395	9.20	9,460
2.90	630	4.50	1,650	6.20	3,690	9.40	9,900
3.00	670	4.60	1,740	6.40	4,000	9.60	10,360
3.10	715	4.70	1,835	6.60	4,320	9.80	10,820
3.20	760	4.80	1,935	6.80	4,655	10.00	11,280
3.30	810	4.90	2,035	7.00	5,000	10.50	12,500
3.40	860	5.00	2,140	7.20	5,355	11.00	13,850
3.50	915	5.10	2,250	7.40	5,725	11.50	15,370
3.60	975	5.20	2,360	7.60	6,110	12.00	17,120
3.70	1,035	5.30	2,475	7.80	6,510	12.50	19,280
3.80	1,100	5.40	2,595	8.00	6,920	13.00	22,090
3.90	1,170	5.50	2,720	8.20	7,330	13.50	25,590
4.00	1,240	5.60	2,845	8.40	7,750	14.00	29,900
4.10	1,315	5.70	2,975	8.60	8,170		
4.20	1,395	5.80	3,110	8.80	8,595		
4.30	1,475	5.90	3,250	9.00	9,025		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is fairly well defined. Owing to the shifting character of the stream bed the lack of sufficient measurements may cause considerable error in the application of this table after August 1, 1904.

Estimated monthly discharge of Arkansas River near Arkansas City, Kans., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	401	165	301	18,510
February	721	272	407	23,410
March	2,530	272	507	31,170
April	2,225	238	531	31,600
May	3,200	510	1,321	81,230
June	24,100	3,110	7,321	435,600
July	40,300	2,035	11,030	678,200
August	1,935	1,100	1,435	88,230
September	1,035	760	847	50,400
October	5,540	810	1,701	104,600
November	975	760	850	50,580
December	860	590	697	42,860
The year	40,300	165	2,246	1,636,000

ARKANSAS RIVER (SALT FORK) NEAR ALVA, OKLA.

This station was established September 10, 1903, by W. G. Russell. It is located at the railway bridge about one-half mile northeast of Alva, Okla. A standard chain gage is attached to the upstream guard rail. The scale is graduated to feet and tenths from 2 feet below to 14 feet above zero. The river bed having sunk may cause minus readings at very low water. The gage is read at irregular periods by Fred. Selfridge. Discharge measurements are made from the upper side of the deck railway bridge to which the gage is attached. This bridge is composed of 146 feet of pile approach at the south end, four 80-foot steel girders resting on stone piers, and 652 feet of pile approach at the north end. The initial point for soundings is at the south end. The channel is curved for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The bed of the stream is composed of clean sand, and is shifting. There are three channels at low and eight at high water. The bench mark is the bottom of the coping stone on the north face of the fourth pier from the south end of the bridge. Its elevation is 8.00 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River (Salt Fork) near Alva, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
August 16	W. G. Russell	118	47	1.36	0.15	64
September 16	do	94	32	1.37	.10	44

Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Alva, Okla., for 1904.

Day.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
1		1.50	1.90	1.00			0.10	0.00	0.00
2		1.50	1.90	4.10			.00	.00	.00
3		1.90	2.10	3.95			.00	.00	.00
4		1.40	2.60	2.00			.00	.00	.00
5		1.80	1.40	1.90			.00	.00	.00
6		1.50	1.00	1.50			.10	.00	.10
7		.80	.80	8.25			.00	.00	.20
8		1.25	.80	3.05	1.60		.00	.00	
9		1.00	2.00	1.65	.50		.00	.00	
10		1.00	2.40	1.50			.00	.00	
11		1.00	1.60	1.50			.10	.00	
12		1.00	1.30	1.50		1.00	.10	.00	
13			1.10	1.00		.60	.10	.00	
14			.80	.80		.20	.10	.00	
15		1.30	.80	.50		.10	.00	.00	
16		1.70	.80	.50		.10	.10	.00	
17		1.00	1.50	.50	1.10	.10	.10	.00	
18			.60	.50	.80	.10	.00	.00	
19			1.40	.50	.70	.10	.00	.00	
20			.90	.50		1.00	.00	.00	
21			.60	.50		.40	.00	.00	
22		1.60	.60	1.00	2.10	.10	.10	.00	
23		1.40	.50	1.35	.90	*a*.00	.00	.00	
24		1.20	.50	1.00	.50	-- .10	.00	.00	
25	1.65	1.20	2.80	.90	.50	— .10	.00	.00	
26	1.15	1.00	2.80	.90	.50	— .10	.00	.00	
27	1.00	1.00	1.90	.50	.40	— .00	.00	.00	
28	.80		1.00	.50	.40	— .10	.00	.00	
29	.80	1.05	1.20	.20		.50	.00	.00	
30	.80	1.00	1.20			.20	.00	.00	
31		1.00					.00		

a The bed was lowered in 1904; hence stream may have flow when gage reads zero or below.

ARKANSAS RIVER (SALT FORK) NEAR TONKAWA, OKLA.

This station was established September 18, 1903, by W. G. Russell. It is located at the highway bridge one-half mile south of Tonkawa, Okla. A plain, staff gage, graduated to feet and tenths, is spiked vertically to the downstream pile of a bent 198 feet from the north end of the bridge. The gage is read by T. J. Bird. Discharge measurements are made from the downstream side of the bridge to which

the gage is attached. The initial point for soundings is at the north end of the bridge. The channel is straight for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The right bank is low, wooded, and subject to overflow. The left bank is high, wooded, and does not overflow. The bed of the stream is composed of clean sand, and is shifting. There is but one channel at low and high stages, broken only by the pile bents supporting the bridge. The bench mark is the top of a nail driven into a 6-inch cottonwood tree about 40 feet east of the north end of the bridge. Its elevation is 10.50 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Arkansas River (Salt Fork) near Tonkawa, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 29	W. G. Russell	338	524	1.66	2.55	871
September 20	do	175	135	.64	1.30	87

Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Tonkawa, Okla., for 1903.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.80	1.50	1.00	17		1.20	1.10	1.10
2		.80	3.00	1.10	18	1.10	1.10	1.10	1.10
3		.80	3.80	1.20	19	1.10	1.00	1.20	1.10
4		.90	3.10	1.10	20	1.10	.90	1.10	1.00
5		1.00	2.70	1.10	21	.90	.90	1.10	1.00
6		1.10	2.10	1.10	22	.90	.90	1.10	1.00
7		1.00	2.00	1.10	23	.80	.80	1.10	1.00
8		1.00	1.90	1.10	24	.80	.70	1.00	1.00
9		.90	1.60	1.10	25	.80	.70	1.00	1.00
10		.90	1.50	1.20	26	.80	.70	1.00	1.00
11		.90	1.40	1.20	27	.80	.70	1.00	.90
12		.90	1.20	1.30	28	.70	.70	.90	1.00
13		1.00	1.20	1.20	29	.70	.70	.90	1.00
14		1.00	1.10	1.20	30	.80	8.00	.90	1.00
15		1.10	1.10	1.10	31		8.00		1.00
16		1.10	1.10	1.10					

Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Tonkawa, Okla., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	1.10	1.00	1.10	1.60	3.30	2.00	2.60	1.60	1.20	1.20	1.30
2	1.00	1.00	1.00	1.00	6.00	4.00	8.40	1.80	1.50	1.20	1.20	1.30
3	1.00	1.00	.90	.90	4.60	5.30	8.00	1.60	1.50	1.20	1.20	1.30
4	1.00	1.00	.90	1.10	4.20	6.50	6.60	1.60	1.50	1.30	1.20	1.30
5	1.00	1.00	.80	1.00	3.50	9.50	4.60	1.60	1.40	1.30	1.20	1.30
6	1.00	1.00	.80	.90	3.20	8.00	8.60	1.60	1.40	1.40	1.20	1.30
7	1.00	1.00	.80	.90	4.00	5.20	14.40	1.60	1.40	1.50	1.30	1.30
8	1.00	1.00	.80	.90	4.20	4.20	9.00	1.60	1.40	1.50	1.20	1.40
9	1.00	1.10	.80	.90	6.60	3.20	6.60	2.80	1.30	1.50	1.20	1.30
10	1.00	1.10	.80	.90	5.00	4.50	10.00	2.60	1.30	1.40	1.20	1.30
11	1.00	1.10	.90	.90	4.00	7.00	14.60	2.00	1.30	1.40	1.20	1.30
12	1.00	1.10	.90	.90	3.20	5.30	12.80	1.60	1.30	1.40	1.20	1.30
13	1.00	1.10	.90	.80	2.80	4.00	11.60	1.00	1.30	1.30	1.30	1.30
14	1.10	1.10	.90	.80	2.40	3.00	9.00	1.00	1.30	1.30	1.30	1.30
15	1.10	1.10	.90	.80	2.40	2.50	7.60	1.60	1.80	1.30	1.20	1.30
16	1.00	1.10	.90	.80	2.60	2.50	5.00	2.00	1.80	1.50	1.20	1.20
17	1.10	1.00	.90	.80	5.00	2.30	4.60	3.00	1.70	1.50	1.20	1.20
18	1.10	1.00	.90	.80	3.80	2.30	3.60	5.00	1.60	1.40	1.30	1.20
19	1.10	1.00	.90	.80	3.60	2.00	3.00	4.20	1.60	1.30	1.30	1.30
20	1.10	1.00	.90	.70	3.00	2.20	3.00	3.90	1.60	1.30	1.30	1.30
21	1.10	1.00	.80	.80	2.60	2.00	3.00	3.40	1.50	1.20	1.30	1.30
22	1.10	1.00	.80	.80	4.30	2.00	2.00	3.40	1.50	1.20	1.30	1.40
23	1.10	1.00	.80	2.10	5.60	2.00	5.00	3.00	1.40	1.30	1.30	1.40
24	1.10	1.00	.80	1.90	5.00	2.10	4.60	2.70	1.50	1.20	1.30	1.40
25	1.10	1.00	.90	3.20	4.00	2.10	3.60	2.60	1.50	1.20	1.30	1.40
26	1.10	1.00	1.20	2.20	3.80	3.00	3.00	2.50	1.50	1.20	1.30	1.40
27	1.10	1.00	1.60	2.00	2.80	2.60	3.00	2.20	1.40	1.10	1.30	1.40
28	1.10	1.00	1.20	1.90	3.00	2.60	2.60	2.00	1.30	1.10	1.30	1.40
29	1.10	1.00	1.40	1.50	2.60	2.00	3.00	1.90	1.20	1.10	1.30	1.40
30	1.10	.....	1.20	1.40	2.70	2.00	1.60	1.90	1.20	1.10	1.30	1.40
31	1.10	.....	1.10	.....	3.00	.....	1.60	1.70	.....	1.20	.....	1.40

CIMARRON RIVER NEAR KENTON, OKLA.

This station was established April 5, 1904, by W. G. Russell. It is located at the highway crossing on the main road, one-half mile north of Kenton, Okla. There are two gages. The first is a plain staff gage 8.5 feet long, graduated to feet and tenths, driven vertically into the bed of the stream and spiked to posts driven into the ground. The second gage is in two sections, the first being the same as and located 70 feet southwest of gage No. 1. The second section is spiked to a cedar post 100 feet east of the first gage. The gage is read at irregular periods by L. A. Wikoff. Discharge measurements are made at low water by wading near the gage. At high stages discharges must be computed from the cross section and slope. The initial point for soundings is on the right bank of the stream. The channel is very narrow and crooked, and the current is sluggish. Both banks are low, wooded, and subject to overflow. The bed of the stream is muddy, but too narrow to shift much. There is but one channel at

low or medium stages, but there may be two at high stages. The bench mark is the top of three nails driven into the west side of a willow tree 18 inches in diameter standing 100 feet southwest of the first gage. Its elevation is 8.15 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Cimarron River near Kenton, Okla., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.40	0.50	3.93	5.53	1.65	7.20	1.00	0.80
2	.....	.40	.50	5.00	6.90	5.15	3.90	.90	.80
3	.....	2.86	.70	1.80	1.80	7.23	2.10	.80	.80
4	.....	1.45	.50	.70	1.30	2.00	1.70	.80	.80
5	0.40	.60	.50	.50	1.10	1.30	1.60	.90	.80
6	.40	.50	.50	.50	4.90	1.20	1.60	.90	.80
7	.40	.40	.50	.50	1.55	1.10	1.60	.90	.80
8	.40	.40	.50	.40	1.20	1.00	1.40	.90	.80
9	.30	.40	.50	.60	1.00	.90	3.50	.80	.80
10	.40	.40	1.05	.70	.90	.80	1.90	.90	.80
11	.40	.40	.50	1.00	.80	.80	1.30	.90	1.00
12	.40	.40	.50	.50	.80	.80	1.10	.80	1.00
13	.40	.40	.90	.50	.80	1.85	1.10	.80	1.00
14	.40	.40	.40	.40	.80	.90	1.20	.80	1.00
15	.40	.40	.40	.40	.80	.80	1.20	.80	1.00
16	.40	.40	.30	.40	.70	.80	1.20	.80	1.00
17	.40	.50	.40	7.05	5.30	.80	1.20	.90	.90
18	.40	.40	.50	5.20	5.10	.80	1.20	.90	.90
19	.40	.40	.30	1.40	5.00	.80	1.10	.90	.90
20	.40	.50	.30	.90	1.90	.80	1.10	.90	.90
21	.40	.50	.30	.60	1.30	1.25	1.10	.90	.90
22	.40	2.87	1.70	4.43	1.20	.80	1.10	.90	.90
23	.40	.70	4.90	4.30	1.10	.80	1.00	.90	.90
24	.40	.50	1.00	1.30	1.00	.80	1.00	.80	.90
25	.40	.50	.60	2.45	1.00	.80	1.10	.80	.90
26	.40	.50	.50	1.30	1.00	.80	1.10	.80	.90
27	.40	.50	.50	.80	.90	4.45	1.00	.80	.90
28	.30	.50	.50	.70	.80	2.10	1.00	.80	.90
29	.40	.80	.40	.70	.80	5.15	1.10	.80	.80
30	.40	1.05	.40	3.80	.80	8.30	1.00	.80	.80
31	.....	.50	.....	5.00	.80	.....	1.00	.....	.....

CIMARRON RIVER NEAR ARKALON, KANS.

This station was established August 15, 1903, by W. G. Russell. It is located about a half mile north of Arkalon, Kans., at the bridge of the Chicago, Rock Island and Pacific Railway. The gage is a 1 by 4 inch pine timber, 12 feet long, graduated to feet and tenths and spiked to a pile bent on the downstream side of the bridge. This is the fifth bent from the south end of the bridge. The gage is read once each day by Elwin Singer. Discharge measurements are made from the bridge, but can be made at low water by wading. The initial point for soundings is at the south end of the bridge, or the right bank of the river. The channel is straight for about 100 feet above and below the station. The stream is sluggish at low water, but will

probably have a good current when high. Both banks are low and liable to overflow. The railroad embankment is high at each end of the bridge, forcing the water to pass beneath the bridge at all stages. There is but one channel, which is shallow except at high water. The bridge rests upon piles, and drift may at times affect the measurements. The bridge is 245 feet long and 15 feet above the bed of the stream. The bench mark is top of the cap at the east end of the second bent from the south end of the bridge. Elevation, 15.76 feet.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Cimarron River near Arkalon, Kans., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 31	W. G. Russell	53	19	1.31	0.90	25
October 27	do		22	1.41	1.30	31

Mean daily gage height, in feet, of Cimarron River near Arkalon, Kans., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.80	0.80	0.80	0.90	0.80	0.80	0.80	0.90	0.80	2.00	1.30	1.30
2	.80	.80	.80	.90	.90	2.00	.80	.80	.80	7.00	1.30	1.30
3	.80	.80	.80	.90	1.10	1.30	.80	.80	.80	5.00	1.30	1.30
4	.80	.80	.80	.80	1.00	1.20	.80	2.30	.80	4.20	1.30	1.30
5	.80	.80	.90	.80	.80	.80	.80	3.00	.80	3.40	1.30	1.30
6	.80	.80	.80	.80	.80	.80	1.60	2.00	.80	2.50	1.30	1.30
7	.80	.80	.80	.80	.80	.90	1.60	1.60	4.00	2.20	1.30	1.30
8	.80	.80	.80	.80	.80	2.60	1.60	1.30	3.20	1.40	1.30	1.30
9	.80	.80	.80	.80	.80	3.80	1.10	1.00	1.60	1.50	1.30	1.30
10	.80	.80	.80	.80	.80	1.70	.90	1.40	.90	1.60	1.30	1.30
11	.80	.80	.80	.80	.80	.80	.80	1.20	.90	1.60	1.30	1.30
12	.80	.80	.80	.80	.80	.80	.80	1.00	.80	1.60	1.30	1.30
13	.80	.80	.80	.80	.80	.80	.80	.80	.80	1.60	1.30	1.30
14	.80	.80	.80	.80	.80	.80	.80	.80	.80	1.60	1.30	1.30
15	.80	.80	.80	.80	.80	.80	.80	.80	.80	1.60	1.30	1.30
16	.80	.80	.80	.80	.80	.80	.80	.80	.80	1.70	1.30	1.30
17	.80	.80	.80	.80	.80	2.60	.80	.80	.80	1.80	1.30	1.30
18	.80	.80	.80	.80	.80	1.60	.80	.80	.80	1.70	1.30	1.30
19	.80	.80	.80	.80	.80	2.00	.80	.80	.80	1.60	1.30	1.30
20	.80	.80	.80	.80	.80	1.20	.80	.80	.80	1.60	1.30	1.30
21	.80	.80	.80	.80	.80	1.00	.80	1.50	.80	1.60	1.30	1.30
22	.80	.80	.80	.80	.80	1.10	.80	2.50	.80	1.40	1.30	1.30
23	.80	.80	.80	.90	.80	1.10	1.40	1.60	.80	1.40	1.30	1.30
24	.80	.80	.80	.90	.80	1.20	1.80	1.00	.80	1.40	1.30	1.30
25	.80	.80	.80	.80	.80	1.00	1.80	.90	.80	1.40	1.30	1.30
26	.80	.80	.80	.80	.80	1.00	1.90	.80	.80	1.30	1.30	1.30
27	.80	.80	.80	.80	.80	1.40	1.70	.80	.80	1.30	1.30	1.30
28	.80	.80	.80	.80	.80	1.30	1.50	.80	.80	1.30	1.30	1.30
29	.80	.80	.80	.90	.80	1.00	1.20	.80	2.00	1.30	1.30	1.30
30	.80	.....	.80	.90	.80	.80	.90	.80	1.30	1.30	1.30	1.30
31	.80	.....	.80	.....	.80	.....	.90	.80	.....	1.30	.....	1.30

CIMARRON RIVER NEAR WAYNOKA, OKLA.

This station was established September 11, 1903, by W. G. Russell. It is located at the railway bridge 2½ miles southwest of Waynoka. The gage is a 1 by 4 inch pine board 12 feet long, spiked to the east side of the eighth pile bent from the east end of the bridge. The observer is M. J. Sunden, the section foreman. Discharge measurements are made from the railway bridge, which is supported on piles and has a total span of 2,158 feet. The initial point for soundings is the east end of the bridge. The channel is straight for 1,000 feet above and below the station. Both banks are liable to overflow at very high water. At low water there are several channels. At high water there is one channel, broken by the bridge supports. Bench mark No. 1 is the top of the cap of the bench to which the gage is spiked. Its elevation is 10.93 feet above the zero of the gage. Bench mark No. 2 is the northeast corner of the cap of the bent at the fill at the east end of the bridge on the downstream side. Its elevation is 10.09 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Cimarron River near Waynoka, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 17	W. G. Russell	426	167	0.73	1.20	122
September 17	do	195	112	.53	1.25	59

Mean daily gage height, in feet, of Cimarron River near Waynoka, Okla., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.8	0.8	1.2	0.3	2.0	0.3	1.0	1.0	1.0	2.5	1.0	1.0
2	.8	.9	1.2	.2	1.5	.3	2.0	1.2	1.0	2.0	1.0	1.0
3	.8	.9	1.2	.2	1.3	1.7	2.5	1.5	1.0	2.0	1.0	1.0
4	.8	1.0	1.2	.2	1.0	1.9	2.0	1.3	1.0	2.0	1.0	1.0
5	.9	1.0	1.2	.2	2.5	1.9	2.0	1.1	1.0	4.5	1.0	1.0
6	.9	1.0	1.1	.2	2.0	1.7	2.5	1.0	1.0	3.0	1.0	1.3
7	.9	1.0	1.0	.2	2.0	1.6	4.6	1.0	.9	2.5	1.0	1.2
8	.9	1.5	.9	.2	1.5	1.5	3.5	2.0	.8	2.0	1.0	1.0
9	.9	1.5	.8	.2	1.5	2.25	2.5	1.8	.7	2.0	1.0	1.0
10	.9	1.5	.8	.2	1.4	2.8	2.2	1.7	.6	1.8	1.0	1.0
11	.9	1.3	.8	.2	1.3	2.7	2.0	1.5	2.0	1.6	1.0	1.0
12	1.2	1.2	.8	.2	1.2	2.7	1.8	1.3	1.6	1.5	1.0	1.0
13	1.4	1.1	.8	.2	1.0	2.5	1.6	1.2	1.4	1.5	1.0	1.7
14	1.3	1.0	.8	.2	1.0	2.5	1.5	1.1	1.2	1.5	1.0	1.7
15	1.2	1.0	.7	.2	1.0	2.3	1.3	1.0	1.0	1.5	1.0	1.7
16	1.1	1.0	.7	.2	1.5	2.3	1.2	1.0	1.0	1.5	1.0	1.3
17	1.0	1.0	.6	.2	1.5	2.0	1.0	1.0	1.0	1.5	1.0	1.3
18	1.1	1.0	.6	.2	1.3	1.8	1.0	2.3	1.0	1.5	1.0	1.2
19	1.2	1.0	.5	.2	1.0	2.0	1.0	2.2	1.0	1.5	1.0	1.1
20	1.2	1.0	.5	.2	.8	2.0	1.0	2.1	1.0	1.3	1.0	1.0
21	1.2	1.0	.5	.3	.6	1.8	1.0	2.0	1.0	1.2	1.0	1.5
22	1.1	1.2	.5	.3	.6	1.8	2.7	2.7	1.0	1.2	1.0	1.5
23	1.0	1.2	.5	.3	.5	1.6	2.3	2.0	1.0	1.2	1.0	1.4
24	1.0	1.2	2.8	.3	.5	1.5	2.0	1.5	1.0	1.1	1.0	1.4
25	.9	1.2	2.3	.3	.4	1.5	1.8	1.3	1.0	1.0	1.0	1.4
26	.9	1.2	.5	.3	.4	2.0	1.6	1.2	1.0	1.0	1.0	1.3
27	.8	1.2	.5	.3	.3	1.8	1.5	1.0	1.0	1.0	1.0	1.3
28	.8	1.2	.5	.3	.3	1.6	1.3	1.0	1.0	1.0	1.0	1.2
29	.8	1.2	.4	.6	.3	1.5	1.2	1.0	1.0	1.0	1.0	1.2
30	.8	.....	.4	1.0	.3	1.0	1.0	1.0	4.5	1.0	1.0	1.1
31	.8	.....	.3	.....	.3	.....	.8	1.0	.....	1.0	.....	1.0

VERDIGRIS RIVER NEAR INDEPENDENCE, KANS.

This station was established April 20, 1904, by M. C. Hinderlider, for the purpose of making flood observations. It is located at the highway bridge three-fourths mile northwest of Independence, Kans. A standard chain gage is attached to the upstream guard rail near the south end of the bridge. The gage reads zero when elevation of bottom of weight is 55.893. When the river is high the gage is read by E. Luck. Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the south face of the north abutment. The channel is straight for one-fourth mile above and below the station. The current is swift. Both banks are high rock cliffs covered with trees. The left bank overflowed in the flood of 1903. The bed of the stream is composed of gravel and bed rock, and is permanent. There is but one channel, divided at higher stages by one stone pier. Bench mark No. 1 is the top of the capstone on the upstream side of the

main pier in the stream, marked "U. S. B. M. No. 1." Its elevation is 44.107 feet above the datum of the gage. Bench mark No. 2 is the top stone of the north abutment at the end of the bridge on the upstream side, marked "U. S. B. M. No. 2." Its elevation is 42.686 feet above the datum of the gage. Bench mark No. 3 is the top of the stone step in the upstream wing of the north abutment, marked "U. S. B. M. No. 3." Its elevation is 38.000 feet above the datum of the gage. Bench mark No. 4 is the top of the stone in the upstream wing wall of the south abutment, marked "U. S. B. M. No. 4." Its elevation is 45.168 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Verdigris River near Independence, Kans., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.
1				25.20		
2			20.75	27.60	19.60	
3			38.48			
4			43.45	35.20		
5			43.85			
6			44.20	37.50	7.20	
7		21.55	44.55	43.70		
8			41.85	48.40		
9			46.10	48.80		
10				44.30		
11				41.10		
12			37.05	34.85		
13			36.25	23.00		
14			23.40	14.00		
15			18.00	10.90		
16			29.65			
17		26.80	35.15	13.60	16.70	
18			40.55		18.80	
19			42.55		16.40	
20			37.30			
21			25.60	10.20		
22			20.40		21.00	
23				8.70	15.30	9.60
24	7.90				11.70	15.10
25	32.90			17.20		
26	36.30		24.20			
27			30.45			
28			32.00	12.70		
29			27.20			
30			21.80	8.10		
31						

VERDIGRIS RIVER NEAR CATOOSA, IND. T.

This station was established September 25, 1903, by W. G. Russell. It is located at the Frisco Railway bridge 2 miles northeast of Catoosa, Ind. T. A standard chain gage is attached to the guard rail of the railway bridge. The scale is graduated to feet and tenths along the guard rail. The gage is read at irregular periods by John L. Calloway. Discharge measurements are made from the single span steel railway bridge and its approaches. The initial point for soundings is at the west end of the bridge, 338 feet from the zero of the gage scale. The channel is straight for 200 feet above and below the bridge. The current is sluggish. Both banks are low, wooded, and subject to overflow, but all water passes beneath the bridge and its approaches. At low water there is one channel, and at high water the channel is broken by the stone piers in the pile supports of the bridge, making five channels. The gaging section is obstructed by broken piles, upon which drift collects. During high water it is impossible to get any but surface velocities, and much of the current out of the main channel has a very slow velocity. The bench mark is the top of the second stone pier from the west and upstream side of the bridge. Its elevation is 50.21 feet above the zero of the gage.

The observations of this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Verdigris River near Catoosa, Ind. T., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 2	W. G. Russell	161	820	3.46	7.20	2,834
June 10	do	852	14,600	3.23	47.20	47,230
June 11	do	854	15,610	3.47	48.40	54,240

Mean daily gage height, in feet, of Verdigris River near Catoosa, Ind. T., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.90	3.50	3.10	4.60	12.00	12.50	37.00	6.50	4.50	5.40	3.20	3.00
2	4.00	3.30	3.10	4.50	7.20	22.30	34.10	6.40	4.40	5.40	3.30	3.00
3	4.00	3.40	3.00	4.50	6.70	28.00	42.30	9.00	4.20	5.40	3.20	3.00
4	3.50	3.40	3.00	4.40	5.90	35.10	44.00	14.00	4.20	4.00	3.30	3.00
5	3.50	3.50	3.00	3.90	6.10	45.85	44.60	10.30	4.30	3.90	3.20	3.00
6	3.50	3.40	3.00	3.80	6.30	46.20	45.00	8.30	4.20	3.80	3.20	3.00
7	3.50	3.30	3.00	3.50	11.30	46.00	47.40	8.00	4.10	3.70	3.20	3.00
8	3.50	3.30	3.00	4.10	16.70	46.30	48.30	7.80	4.10	3.60	3.20	3.00
9	3.50	3.30	3.00	3.70	20.00	46.60	48.30	7.40	4.00	3.60	3.20	3.00
10	3.40	3.30	3.00	4.00	15.40	47.60	48.30	7.20	3.90	3.50	3.20	3.00
11	3.30	3.30	3.00	4.90	17.00	48.40	48.40	7.00	3.80	3.40	3.20	3.00
12	3.30	3.30	3.00	4.90	11.20	48.80	48.80	6.90	3.80	3.30	3.20	3.00
13	3.30	3.30	3.00	5.00	10.20	47.40	49.40	5.60	3.70	3.30	3.20	3.00
14	3.30	3.30	3.00	4.90	7.70	45.30	49.40	5.60	3.70	3.20	3.10	3.00
15	3.30	3.30	3.00	4.80	7.00	43.90	48.80	5.50	3.60	3.20	3.10	3.00
16	3.30	3.30	3.00	4.70	6.90	43.00	45.50	5.40	4.20	3.20	3.10	3.00
17	3.30	3.30	3.00	4.60	6.40	37.00	33.10	5.30	4.00	3.50	3.10	3.00
18	3.30	3.30	3.00	4.50	18.00	35.70	28.30	5.10	3.70	3.50	3.10	3.00
19	3.30	3.30	3.00	3.90	20.40	35.00	20.20	5.10	3.70	3.40	3.10	3.00
20	3.30	3.30	3.00	3.80	22.80	34.90	12.40	17.00	3.60	3.40	3.10	3.00
21	5.40	3.30	2.90	3.70	13.90	33.90	10.40	13.00	3.60	3.40	3.00	3.00
22	6.10	3.30	2.90	3.60	12.20	36.70	9.50	9.10	3.70	3.30	3.00	3.00
23	5.40	3.30	2.90	3.60	11.00	37.20	8.50	16.10	3.70	3.30	3.00	3.00
24	5.60	3.30	2.90	4.60	9.30	33.20	8.50	29.10	8.30	3.30	3.00	3.00
25	5.40	3.30	3.60	18.10	8.90	31.30	8.40	24.90	12.60	3.20	3.00	3.00
26	5.40	3.30	4.40	26.90	7.00	22.25	8.00	16.10	12.10	3.20	3.00	3.00
27	4.80	3.20	4.20	30.30	6.80	26.40	7.60	8.00	11.00	3.20	3.00	3.00
28	4.50	3.20	4.00	31.40	6.50	41.30	7.00	6.10	5.50	3.20	3.00	3.00
29	4.10	3.10	7.10	32.70	8.50	42.60	6.40	5.20	5.40	3.20	3.00	3.00
30	3.80	.....	5.80	23.85	7.00	39.10	6.10	4.70	5.40	3.20	3.00	3.00
31	3.60	.....	4.70	.....	8.00	.....	6.20	4.60	.....	3.20	.....	3.00

FALL RIVER AT FALLRIVER, KANS.

This station was established as a flood station, April 22, 1904, by M. C. Hinderlider. It is located at the highway bridge, one-eighth mile north of Fallriver, Kans. The original gage was a standard wire and weight gage bolted to the downstream railing near the left end of the bridge. The scale, graduated to feet and tenths from zero to 40 feet, extends horizontally along the rail. The elevation of the bottom of the weight when the gage reads zero is 58.232. On August 28, 1904, the wire cable was replaced by the regulation chain, at the same datum. During 1904 the gage was read once daily, or hourly during dangerous rises in the stream, by Jesse McDaniel. Discharge measurements are made from the three-span bridge to which the gage is attached. The initial point for soundings is the surface of the ground at the north side of the right abutment. The channel is straight for about 300 feet above and 500 feet below the station, and the current is sluggish at low stages and swift at high stages. The

right bank is of loam, sloping gradually out for about 100 feet, then sandstone cliffs from 10 to 15 feet high. The left bank slopes at an angle of about 45° to the height of the bridge floor. Both banks are timbered, and do not overflow except at extreme stages. The low ground on the left bank extending outward from the northwest end of the bridge is overflowed at very high stages of the river. The bed of the stream is composed of loam and mud, and is probably unstable. Bench mark No. 1 is the top of the south masonry abutment on the downstream side; its elevation is 41.768 feet above gage datum. Bench mark No. 2 is on the sandstone ledge at the foot of the northeast corner of the south abutment; its elevation is 33.777 feet above gage datum. Bench mark No. 3 is the top of the first pier from the right bank on the downstream side; its elevation is 41.028 feet above gage datum. Bench mark No. 4 is the top of the second pier from the right bank, downstream end; its elevation is 40.076 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Fall River at Fallriver, Kans., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.35	13.15	11.85	3.90	2.40	2.40	2.20
2	.....	5.35	10.00	22.25	4.10	2.40	2.40	2.20
3	.....	5.65	25.75	10.25	3.65	2.30	2.40	2.20
4	.....	7.25	29.45	12.20	3.45	2.20	2.40	2.20
5	.....	11.15	11.40	15.25	3.25	2.20	2.40	2.20
6	.....	16.10	7.95	33.05	3.05	2.20	2.40	2.20
7	.....	9.05	6.40	30.75	3.00	2.20	2.40	2.20
8	.....	12.00	5.50	33.05	3.00	2.20	2.40	2.10
9	.....	9.45	11.15	10.20	3.00	2.15	2.40	2.10
10	.....	6.55	29.15	16.27	3.00	2.10	2.40	2.10
11	.....	5.25	25.85	11.50	3.00	2.10	2.40	2.10
12	.....	4.95	9.25	7.25	2.90	2.10	2.45	2.10
13	.....	5.50	7.70	6.35	2.80	2.10	2.40	2.10
14	.....	5.20	10.85	6.00	2.70	2.10	2.35	2.00
15	.....	5.95	8.40	10.20	2.70	2.10	2.35	2.00
16	.....	17.00	36.70	7.25	2.70	2.10	2.35	2.00
17	.....	9.05	22.25	4.90	2.70	2.10	2.30	2.00
18	.....	7.30	8.95	4.45	3.65	2.05	2.30	2.00
19	.....	6.65	12.10	4.20	3.40	2.00	2.30	2.00
20	.....	6.15	7.55	4.00	3.25	2.00	2.30	2.00
21	.....	6.65	7.80	3.75	3.70	2.00	2.20	2.00
22	3.50	6.10	5.70	3.55	3.55	2.40	2.20	2.00
23	4.00	5.55	7.10	3.50	3.50	2.40	2.20	2.00
24	27.90	4.90	4.90	3.50	3.45	2.35	2.20	2.00
25	13.50	4.50	16.27	3.50	3.30	2.25	2.20	2.00
26	8.30	10.15	9.60	3.50	2.95	2.30	2.20	2.00
27	6.30	6.75	13.75	3.50	2.75	2.40	2.20	2.00
28	6.05	5.30	7.60	3.90	2.60	2.40	2.20	2.00
29	5.85	5.80	12.50	4.10	2.60	2.40	2.20	2.00
30	5.70	7.00	14.25	3.65	2.50	2.40	2.20	2.00
31	.....	6.70	.....	3.45	2.45	.....	2.20	.....

NEOSHO RIVER NEAR NEOSHO RAPIDS, KANS.

This station was established as a flood station May 11, 1904, by W. G. Russell. It is located at the Atchison, Topeka and Santa Fe Railway bridge, about 2 miles below the junction of Neosho and Cottonwood rivers and about 1 mile west of Neosho Rapids.

The gage consists of a standard wire and weight gage located on the downstream side of the railroad bridge near the left or east end. The gage is marked on the guard rail of the bridge from zero to 40 feet, the foot marks being shown by brass headed nails and the tenth marks by ordinary tacks.

During the season of 1904 the gage was read twice daily by L. H. Hendrickson, section foreman for the Atchison, Topeka and Santa Fe Railway at Neosho Rapids. Discharge measurements are made from the downstream side of the railroad bridge to which the gage is attached. The initial point for soundings is the west face of the east masonry abutment on the downstream side of the bridge. There is but one channel, which is straight for several hundred feet above and below the bridge, the current being sluggish at low and fairly rapid at high stages. The bed of the stream is composed of mud and silt and irregular. Owing to the irregular shape of the bed of the channel an island appears in the channel beneath the bridge at low water. Both banks are of loam, and rise above low water for a height of from 10 to 15 feet, but are overflowed during high stages of the river, cultivated lands on either side being flooded for long distances out.

Bench mark No. 1 is a cross on the top of the left abutment on downstream side; its elevation is 38.75 feet above the datum of the gage. Bench mark No. 2 is a mark on the top of the southwest corner of the left abutment; its elevation is 35.71 feet above the datum of the gage. Bench mark No. 3 is a mark on the top of the southwest corner of the coping of the left abutment; its elevation is 33.71 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Neosho River near Neosho Rapids, Kans., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	31.40	21.20	12.75	11.60	9.85	9.50
2	.....	28.55	16.85	12.60	11.80	9.95	9.50
3	.....	32.50	18.55	12.50	11.70	10.05	9.50
4	.....	34.75	19.75	12.65	11.55	9.90	9.50
5	.....	33.20	26.10	12.40	11.40	9.85	9.50
6	.....	30.25	32.20	12.15	11.40	9.80	.....
7	.....	27.55	35.25	12.30	11.40	9.80	.....
8	.....	26.05	35.15	12.30	11.40	9.80	.....
9	.....	18.35	34.15	12.00	11.40	9.80	.....
10	.....	19.40	33.65	12.00	11.40	9.80	.....
11	.....	29.35	33.10	12.15	9.90	9.80	.....
12	.....	29.05	32.40	12.05	9.90	9.80	.....
13	.....	24.25	29.70	12.00	9.80	9.80	.....
14	.....	17.25	25.05	11.95	9.80	9.80	.....
15	13.60	16.25	16.80	11.90	10.05	9.70	.....
16	20.80	18.05	16.95	11.90	9.90	9.65	.....
17	26.70	21.00	16.25	11.90	9.90	9.60	.....
18	26.05	23.35	14.80	11.90	9.80	9.60	.....
19	20.45	25.85	12.80	11.90	9.80	9.60	.....
20	14.35	25.35	17.50	11.90	9.80	9.60	.....
21	13.70	18.95	14.20	11.90	9.80	9.60	.....
22	13.55	15.80	17.90	12.15	9.80	9.60	.....
23	13.40	14.75	18.50	13.75	9.80	9.50	.....
24	13.30	14.00	15.20	13.80	9.90	9.50	.....
25	12.90	23.85	14.90	12.50	9.90	9.50	.....
26	14.45	31.65	13.50	11.90	9.90	9.50	.....
27	21.05	33.05	13.50	11.90	9.90	9.50	.....
28	19.20	30.40	13.45	11.80	9.80	9.50	.....
29	25.00	26.85	13.25	11.75	9.80	9.50	.....
30	33.05	24.90	13.00	11.60	9.80	9.50	.....
31	32.80	.....	12.90	11.60	.....	9.50	.....

NEOSHO RIVER NEAR HUMBOLDT, KANS.

This station was established as a flood water station April 19, 1904, by M. C. Hinderlider. It is located at the highway bridge about one-half mile west of Humboldt, Kans. A standard wire and weight gage was fastened to the downstream guard rail of the bridge near the left end. The scale is graduated to feet and tenths. On August 30, 1904, the wire cable of the gage was replaced by a regulation chain, at the same datum. The gage was read once daily, and oftener during sudden changes in the stage of the river during the flood periods of 1904, by W. P. McGrew. Discharge measurements are made from the single-span bridge to which the gage is attached. The initial point for soundings is at the foot of the perpendicular cliff on the left bank of the river, at the east end of the bridge. The channel is permanent, having a sandstone bottom. The current is sluggish at low and fairly swift at high stages of flow. The right bank is low, timbered, and is subject to overflow. The left bank is high, and is not subject to over-

flow. The bed of the stream is composed of solid rock, and permanent. There is a masonry dam about 100 yards below the bridge, used for developing power for the gristmill near by. This dam is 300 feet long, there being a difference between the surface of the river above and below the dam of 7.14 feet. Bench mark No. 1 is a United States Geological Survey standard bench mark tablet, set into the stone coping in the south side of the Humboldt National Bank building, on the northwest corner of Eighth and Bridge streets, midway between the two south windows, two feet above the top of the sidewalk. Its elevation is 69.629 feet above the datum of the gage. Bench mark No. 2 is a cross on the cliff, 10 feet south and 15 feet west of the left end of the bridge. It is marked "U. S. B. M." Its elevation is 20.942 feet above gage datum. Bench mark No. 3 is a cross on the top of the third stone from the bottom in the south face of the south wing of the right abutment. It is marked "B. M." Its elevation is 12.225 feet above the datum of the gage. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Neosho River near Humboldt, Kans., for 1904.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	.....	21.00	22.80	17	.....	18.75	18.00	12.00
2	.....	.....	22.95	21.80	18	.....	18.00	13.20	7.00
3	.....	.....	28.15	13.90	19	.....	16.80	12.80	.....
4	.....	.....	28.90	11.65	20	.....	15.65	15.10	.....
5	.....	.....	27.60	13.35	21	.....	7.50	15.90	.....
6	.....	11.00	27.30	24.20	22	.....	.....	14.00	.....
7	.....	13.00	28.30	26.75	23	3.00	.....	9.20	.....
8	.....	11.90	27.40	28.50	24	[a]25.90	.....	6.00	.....
9	.....	.....	25.95	29.25	25	25.00	4.00	14.90	.....
10	.....	.....	24.50	30.50	26	.....	15.20	23.05	.....
11	.....	.....	18.35	29.75	27	.....	9.50	25.95	.....
12	.....	.....	13.25	28.70	28	.....	11.45	24.65	.....
13	.....	.....	15.70	27.25	29	.....	10.95	23.40	.....
14	.....	.....	17.10	26.10	30	.....	16.85	23.10	.....
15	.....	.....	13.15	25.05	31	.....	19.45	.....	.....
16	.....	.....	15.75	22.95					

[a] Extreme height 29.5.

GRAND RIVER NEAR FORT GIBSON, IND. T.

This station was established September 22, 1903, by W. G. Russell. It is located at the Missouri Pacific Railway bridge three-fourths of a mile northwest of Fort Gibson, Ind. T. There are two gages. The first is a vertical 2 by 6 inch plank 18 feet long, graduated to feet and tenths from 9 to 27 feet, bolted to the east face of the first stone pier from the left bank. The 9-foot mark is the top of the steel caisson, and below this point gage heights are taken by means of a standard

chain gage let down from a nail in the guard rail, and kept in the pump house when not in use, the scale reading to feet and tenths from zero to 35 feet, being marked along the guard rail. This gage is used only in very low or very high water. Gage heights are taken once each day by W. L. Blackwell. Discharge measurements are made from the downstream side of the three-span steel bridge to which the gages are attached. The bridge has a total length of 625 feet, and has a pile approach of 157 feet at the west end. The bridge is slightly oblique to the course of the current. The initial point for soundings is the edge of the abutment on the left bank of the river. The channel is straight for about 500 feet above and below the station. The current is sluggish except at high water, when it is swift near the right bank. The right bank is high, wooded, and overflows only at very high stages. The left bank is high, rocky, clean, and does not overflow. The bed of the stream is a smooth rock from the left bank to the middle, when it changes to sand and changes with every flood. There are four channels at low and five channels at high water. Drift at very high water makes it possible to get only top velocities. Bench mark No. 1 is a cross, marked "B. M.," on a hard limestone rock in the face of the wall 4 feet above the upstream side of the bridge on the left bank of the river. Its elevation is 24.90 feet above the datum of the gage. Bench mark No. 2 is a United States Geological Survey standard bench mark on the top of the east pier of bridge. It is 516 feet above sea level, and is marked "516." Its elevation is 40.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Grand River near Fort Gibson, Ind. T., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 3	W. G. Russell	479	5,630	5.50	15.65	30,960
June 8	do		11,600	6.93	27.00	80,400
June 12	do		10,140	6.15	24.45	62,410
August 31	do	491	4,074	1.37	11.00	5,571

Mean daily gage height, in feet, of Grand River near Fort Gibson, Ind. T., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.60	11.00	9.10	11.50	17.80	14.00	18.80	14.60	11.00	10.00	9.20	9.0
2	9.50	11.00	9.10	12.00	17.60	18.60	18.20	16.20	11.00	10.80	9.20	9.0
3	9.40	11.00	9.10	12.00	15.80	20.00	20.00	17.80	11.00	10.60	9.30	9.0
4	9.40	10.60	9.10	12.00	13.60	26.50	21.00	19.50	11.00	10.40	9.30	9.0
5	9.40	10.50	9.10	12.00	13.00	33.00	22.60	19.80	11.00	10.20	9.30	9.0
6	9.40	10.00	9.10	12.00	12.00	32.60	23.00	17.00	10.90	10.00	9.40	9.0
7	9.40	10.00	9.10	12.00	11.20	29.00	26.00	16.50	10.90	9.80	9.40	9.0
8	9.40	10.00	9.10	11.80	11.40	27.00	27.00	16.00	10.80	9.60	9.40	9.0
9	9.10	10.00	9.10	11.60	11.80	27.00	28.00	15.20	10.80	9.40	9.40	9.0
10	9.40	10.00	9.10	11.60	12.00	25.50	29.00	14.00	10.80	9.20	9.40	9.0
11	9.40	10.00	9.10	11.60	12.80	25.50	32.40	13.80	10.90	9.20	9.40	8.9
12	9.40	9.60	9.10	11.50	13.00	24.00	32.20	13.60	11.00	9.00	9.50	8.9
13	9.40	9.40	9.00	11.50	12.00	24.00	32.00	13.00	11.00	8.80	9.40	8.9
14	9.40	9.30	9.00	11.20	11.10	23.20	31.60	13.80	10.90	8.80	9.20	8.9
15	9.30	9.30	9.00	11.00	11.40	20.00	30.80	13.60	10.00	8.60	9.20	8.9
16	9.30	9.30	9.00	11.00	11.80	19.50	30.00	13.40	10.00	8.60	9.20	8.9
17	10.00	9.30	9.00	11.00	12.00	17.00	25.00	13.00	10.00	8.60	9.20	8.9
18	10.00	9.30	9.00	11.00	12.80	16.50	24.60	12.80	10.80	8.60	9.10	9.0
19	10.00	9.30	9.00	11.00	13.00	17.00	23.00	11.60	10.80	8.60	9.10	9.0
20	10.00	9.30	9.00	11.00	14.00	17.50	21.00	10.50	11.00	8.60	9.10	9.0
21	10.20	9.30	9.10	11.00	14.00	18.20	19.20	10.80	11.00	8.80	9.10	9.0
22	13.00	9.20	9.10	10.80	13.80	18.00	19.00	11.00	11.00	8.80	9.10	9.0
23	15.50	9.20	9.10	10.50	13.40	17.10	18.20	11.50	11.00	8.80	9.10	9.0
24	15.00	9.20	9.20	10.50	12.20	16.40	16.00	12.00	11.80	9.20	9.00	9.0
25	14.80	9.10	9.20	10.80	12.00	15.00	15.80	12.80	11.80	9.20	9.00	9.0
26	14.40	9.10	9.20	10.90	11.80	15.40	15.20	13.00	11.60	9.20	9.00	9.0
27	14.00	9.10	9.30	11.80	11.60	16.00	14.80	13.50	11.40	9.20	9.00	9.0
28	13.00	9.10	9.70	13.50	11.20	18.80	14.40	13.00	11.20	9.20	9.00	9.0
29	12.00	9.10	9.80	17.80	11.80	19.00	13.80	12.00	11.00	9.20	9.00	9.0
30	11.00	.....	10.00	18.00	12.00	19.80	14.00	11.00	10.80	9.20	9.00	9.0
31	11.00	.....	10.40	.....	13.00	.....	14.40	11.00	.....	9.20	.....	9.0

SOUTH CANADIAN RIVER NEAR LOGAN, N. MEX.

This station was established June 29, 1904, by W. G. Russell. It is located at the bridge of the Chicago, Rock Island and Pacific Railroad 1 mile west of the depot at Logan, N. Mex. A plain staff gage, graduated to feet and tenths from zero to 4 feet, is bolted to the cribwork of a submerged dam about 25 feet below the bridge. The remainder of the gage up to 14 feet is painted upon the concrete pier of the bridge just above. The gage is read once each day by John W. Furlow. Discharge measurements can be made only at low water by wading. For high water stages it will be necessary to compute the discharge from the slope and cross section or by float measurements. As the bridge piers divide the river into several sections, it is quite easy to obtain surface velocities of each. It is impossible to make measurements from the railroad bridge, as it is a narrow deck bridge 136 feet above the bed of the river. The initial point for discharge measurements is at the east end of the railway bridge. The

channel is straight for about 2,000 feet above and below the station, and the current is moderate at ordinary and swift at high stages. Both banks are high, rocky, clean, and do not overflow. The bed of the stream is composed of clean sand, and is shifting. The bench mark is the 4.5 foot gage mark on the concrete pier on the side facing the river. At low water there are three channels and at high water one, except as broken by 7 bridge piers.

During the floods of October 1, 1904, the lower section of the original gage was buried by sand, and the channel changed to the west side of the river. The upper section of the gage is to be destroyed, as the railway bridge will have to be rebuilt. A plain, vertical, staff gage has been attached to a temporary highway bridge about 750 feet below the old gage. This bridge will likely stay in place until the new railway bridge is built, unless washed out by floods. The new gage is graduated to feet and tenths from zero to 8 feet, with its zero placed 4.32 feet below the zero of the old gage. It was necessary to place this zero below the other, or have both positive and negative readings. Bench mark No. 1 is the top of a projecting point on a sandstone ledge about 100 feet north of the north end of the highway bridge, marked with a cross and the letters "B. M." Its elevation is 22.15 feet above the zero of the old gage. Bench mark No. 2 is a cross, marked "B. M.," on the top of a point of rock about 100 feet east of the second steel bent of the railway bridge, 115 feet south of the north end. Its elevation is 23.55 feet above the zero of the old gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of South Canadian River near Logan, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 29	W. G. Russell	245	64	0.87	0.55	56
August 10	do	388	1,400	[a] 5.32	4.50	7,446
October 2	do		13,520	11.05	31.30	149,400
October 22	do	119	174	[b] 3.72	3.00	647

[a] Float measurement velocity obtained from slope. [b] Float measurement.

Mean daily gage height, in feet, of South Canadian River near Logan, N. Mex., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.50	1.50	0.40	30.00	2.70	2.0
2	2.00	5.00	.45	(a)	2.60	2.0
3	3.00	4.00	3.25	.....	2.55	2.0
4	3.50	2.50	3.05	.....	2.45	2.0
5	2.50	1.50	1.75	.....	2.40	2.0
6	1.90	1.00	.90	.....	2.40	2.0
7	1.80	1.40	.70	.....	2.50	2.2
8	2.00	1.00	.60	.....	2.50	2.2
9	2.80	3.50	.55	.....	2.50	2.2
10	1.60	4.50	.50	.....	2.50	2.1
11	1.30	3.50	.50	.....	2.50	2.1
12	3.50	1.20	.50	.....	2.40	2.1
13	1.10	.80	.45	.....	2.40	2.0
14	1.30	.60	.40	.....	2.40	2.0
15	.80	.60	.40	.....	2.40	2.0
16	.60	.55	.40	.....	2.30	2.0
17	.50	3.35	.40	.....	2.30	2.0
18	3.30	2.25	.30	.....	2.20	2.0
19	1.50	1.60	.30	.....	2.10	2.0
20	2.00	1.20	.30	.....	2.10	2.1
21	1.00	.95	.20	.....	2.10	2.2
22	3.35	1.80	.20	.....	2.00	2.2
23	3.00	1.85	.20	b3.00	2.00	2.2
24	1.70	1.20	.20	2.90	2.00	2.0
25	1.30	.75	.45	2.85	2.00	2.0
26	1.00	.70	.80	2.80	2.00	2.3
27	1.70	.55	2.35	2.75	2.00	2.3
28	1.20	.50	4.25	2.75	2.00	2.2
29	1.40	.50	7.50	2.70	2.00	2.2
30	.90	.40	25.00	2.70	2.00	2.1
31	1.80	.40	.....	2.70	.....	2.0

a Gage destroyed October 2.

b Gage reestablished.

MORA RIVER AT LA CUEVA, N. MEX.

This station was established August 25, 1903, by M. C. Hinderlider. It is located at the wagon bridge in the town of La Cueva, N. Mex. The gage is a vertical rod, graduated to feet and tenths from zero to 7 feet, fastened to the west end of the north abutment of the wagon bridge. The zero of the rod is on the bed of the stream. The gage is read twice each day by Hugh Loudon, of the La Cueva Land and Cattle Company. Discharge measurements are made by wading just below the bridge to which the gage is attached or from the bridge at high stages. The channel is tortuous above and below the station. The right bank is a high, rocky bluff. The left bank is a loam bank about 6 feet high, lined with willows and covered with alfalfa fields, and overflows at high water. The bed of the stream is composed of sand and gravel, and is somewhat shifting. There is but one channel except at very high stages, when the left bank is overflowed. Con-

ditions are favorable for good results. Practically all the water is diverted by the La Cueva canal just above the station, but is returned below. Gagings are made in the canal to determine the amount of water carried. During the flood of September 29, 1904, the bridge and gage were carried away. Records were discontinued for the remainder of the year, but the station will be reestablished in the spring of 1905.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1904.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		0.80	9		0.70	17	0.90	0.30	25	0.75	1.25
2		.70	10		.70	18	.70	.30	26	1.05	1.25
3		.85	11		.65	19	.75	.80	27	.85	1.25
4		.75	12		.75	20	.70	.70	28	.80	1.25
5		.70	13		.60	21	.70	.65	29	.65	1.20
6		.70	14		.50	22	.85	.75	30	.65	1.15
7		.60	15	0.55	.50	23	.80	1.45	31		
8		.60	16	1.10	.35	24	.80	1.10			

MORA CANAL AT LA CUEVA, N. MEX.

Mora canal diverts water from Mora River a short distance above the gaging station maintained on Mora River at La Cueva, N. Mex., and returns a portion of the same below the station. At times a portion or all of the water in the canal is passed through the wheel of a grist mill or waste gate directly back to the river above the gage. At other times a portion or all the water in the canal is carried to storage reservoirs and not returned to the river. Gagings are made from the footbridge crossing the canal just north of the Mora River gaging station in order to determine the total amount of water carried by the river when water in the canal is being stored. The gage is a vertical staff, graduated to feet and tenths from zero to 2.9 feet, set at the right bank of the canal opposite the store building. The zero of the gage rests on the bottom of the canal. The gage is read twice each day by Hugh Loudon, of the La Cueva Land and Cattle Company. The bench mark is a cross marked with the letters "B. M." chiseled into one of the foundation stones of the store building, 1 foot above the ground and almost opposite the gage rod. Its elevation is 7.008 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Mora canal at La Cueva, N. Mex., for 1904.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		0.70	9		0.75	17	0.90	0.35	25	0.65	1.00
2		.80	10		.75	18	.85	.30	26	1.00	1.45
3		.85	11		.65	19	.90	.75	27	.75	1.25
4		.80	12		.55	20	.80	.65	28	.70	.85
5		.70	13		.70	21	.85	.65	29	.60	.90
6		.70	14		.50	22	.90	1.00	30	.65	.25
7		.60	15	0.65	.50	23	.75	1.50	31		
8		.70	16	.90	.35	24	.70	1.45			

MORA RIVER AT WEBER, N. MEX.

This station was established August 21, 1903, by M. C. Hinderlider. It is located at the highway bridge 150 feet north of the post-office at Weber, N. Mex., and is about 15 miles west of Watrous, N. Mex. The gage is a vertical 2 by 6 inch timber 14 feet long, fastened to the upstream end of the south abutment of the wagon bridge. The zero of the gage rests on the bed of the river. It is read twice each day by Mrs. Emily Biernbaum, the postmaster at Weber. Discharge measurements are made during the greater part of the year by wading below the bridge. At high water they are made from the highway bridge which consists of a single span of 32 feet. The initial point for soundings is the edge of the left abutment. The channel is straight for 20 feet above and for 75 feet below the bridge. Both banks are of gravel and overflow only at high stages. The bed of the stream is composed of bowlders and mud, overlying shale or stone, with a sand bar near the right bank just below the bridge during low water. A few feet below the bridge the channel is filled across with riprap, is shifting, and free from vegetation. Bench mark No. 1 is a 20-penny nail driven horizontally into the northwest face of a large cottonwood tree 75 feet southeast of the gage. A spike is driven on each side of the bench mark. The elevation of the bench mark is 12.921 feet above the zero of the gage. Bench mark No. 2 is a 20-penny nail driven vertically into the top side of the east end of the cap timber of the north abutment of the bridge. Its elevation is 10.114 feet above the zero of the gage.

On September 29, 1904, this station was destroyed by the greatest flood ever known to have occurred on Mora River. The bridge and gage rod were carried away and all the buildings at Weber were destroyed. Since the flood this station has not been reestablished, as the observer moved away and no one else was available.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurement of Mora River at Weber, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
October 12.....	G. B. Monk	37	73	2.71	(a)	198

a Gage destroyed September 30, 1904.

Mean daily gage height, in feet, of Mora River at Weber, N. Mex., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.10	2.00	1.90	1.90	1.90	3.35	1.80
2	2.10	2.00	1.90	1.90	2.50	3.15	1.80
3	2.10	2.00	1.90	1.90	2.55	6.10	1.80
4	2.10	2.00	1.90	1.90	2.05	3.00	1.80
5	2.10	2.00	1.90	1.90	1.90	2.90	1.80
6	2.10	2.00	1.90	1.90	1.90	3.30	1.80
7	2.10	2.00	1.90	1.90	1.90	2.85	1.80
8	2.10	2.00	1.90	1.90	1.90	2.30	1.80
9	2.10	1.95	1.90	1.90	1.90	2.35	1.80
10	2.10	1.90	1.90	1.90	1.90	2.25	1.80
11	2.10	1.90	1.90	1.90	1.90	2.20	1.80
12	2.10	1.90	1.90	1.90	2.95	2.20	1.80
13	2.10	1.90	1.90	1.90	2.20	2.15	1.80
14	2.15	1.90	1.90	1.90	1.95	2.10	1.80
15	2.10	1.90	1.90	1.90	1.90	2.10	1.80
16	2.10	1.90	1.90	2.35	1.90	1.90	1.80
17	2.10	1.90	1.90	2.40	1.90	2.45	1.80
18	2.10	1.90	1.90	1.95	1.90	2.30	1.80
19	2.08	1.90	1.90	1.90	2.30	2.15	1.80
20	2.05	1.90	1.90	1.90	1.90	1.95	1.80
21	2.05	1.90	1.90	1.90	1.90	1.90	1.90
22	2.05	1.90	2.25	2.10	2.35	1.90	1.90
23	2.05	1.95	1.90	1.90	3.30	1.85	2.00
24	2.05	2.00	1.90	1.90	2.55	1.80	1.90
25	2.05	2.00	1.90	1.85	3.80	1.75	1.90
26	2.00	1.90	1.90	1.80	2.90	1.65	1.85
27	2.00	1.90	1.90	2.00	3.00	1.60	2.50
28	2.00	1.90	1.90	2.20	2.95	1.70	3.65
29	2.00	1.90	1.90	1.95	2.40	1.70	8.50
30	2.00	1.90	1.90	1.90	2.35	1.80	(a)
31	2.00	.....	1.90	.....	2.30	1.80	.....

a Gage destroyed September 30.

SAPELLO RIVER AT SAPELLO, N. MEX.

This station was established August 12, 1903, by E. G. Marsh. It is located about one-half mile above the junction of Sapello and Manuelitos rivers, and is about 12 miles from Las Vegas, N. Mex. The gage is an inclined 1 by 8 inch pine board 10 feet long, bolted to the rock and braced with timbers. It is read once each day by Horace R. Titlow. Discharge measurements may be made by wading, but at high stages a cable, car, tagged wire, and stay wire will be necessary.

The initial point for soundings is a cross in the ledge of rock on the east bank. The channel is winding above and below the station, and will overflow both banks except at the station. The bed of the stream is composed of gravel above and below the station. At the station the bed is an outcrop of rock covered with about 6 inches of shifting sand. The bench mark consists of two arrows with the letters B. M. cut in the ledge of rock on the east bank 10 feet downstream from the gaging section. Its elevation is 12.57 feet above the zero of the gage.

This station was abandoned in March, 1904, being replaced by the station farther down the Sapello at Los Alamos. Owing to the great drought of 1903 no discharge measurements were made.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Sapello River at Sapello, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	0.60	0.60	0.50	12	0.60	0.60	0.50	22	0.60	0.50	0.40
2	.60	.60	.50	13	.60	.60	.50	23	.60	.50	.40
3	.60	.60	.50	14	.60	.60	.50	24	.60	.50	.40
4	.60	.60	.50	15	.60	.60	.40	25	.60	.50	.40
5	.60	.60	.50	16	.60	.60	.40	26	.60	.50	.40
6	.60	.60	.50	17	.60	.60	.40	27	.60	.50	.40
7	.60	.60	.50	18	.60	.60	.40	28	.60	.50	.40
8	.60	.60	.50	19	.60	.50	.40	29	.60	.50	.40
9	.60	.60	.50	20	.60	.50	.40	30	.60	.....	.40
10	.60	.60	.50	21	.60	.50	.40	31	.60	.....	.40
11	.60	.60	.50								

SAPELLO RIVER NEAR LOS ALAMOS, N. MEX.

This station was established August 22, 1903, by M. C. Hinderlider. It is located at a ford crossing Sapello River at a point due north from Los Alamos and about one-fourth mile distant. The gage consists of a 2 by 6 inch timber, 16 feet long, placed in an inclined position on the right bank of the river at the ford. It is graduated to read directly to vertical tenths of feet from 0.5 foot to 7.5 feet. There is no bridge and no other means of making high-water measurements. This station later took the place of the stations on the Sapello and Manuelitos rivers at Sapello when the latter were abandoned in March, 1904. All measurements are made by wading. The initial point for soundings is the right bank. The channel is straight for 200 feet above and below the station. The current is moderate at ordinary stages and rapid at flood stages. The right bank is high and steep and does not overflow at the gage. The left bank is a low sand and gravel bar extending for about 100 feet and then rising to above high-water mark. The bed of the stream is composed of small cobblestones, gravel, and sand, and is apparently permanent. The

cross section is regular, and there is one channel at all stages. The bench mark is a 20-penny spike driven horizontally into the northwest face of a 10-inch willow tree about 3½ feet above the ground. The tree is about 100 feet southeast of the gage, and there is a spike driven on each side of the bench mark. The elevation of the bench mark is 17.815 feet above the zero of the gage. The gage is read twice each day by W. B. Hogin.

A cable was placed across this stream about 500 feet above the gage rod, equipped with car and tag wire, in March, 1904, from which gagings at high stages are made. This station was established for the purpose of determining the available amount of water for prospective diversion into the Sanguyjuella basin for storage. This basin lies about 6 miles northwest of Las Vegas.

The following discharge measurement was made by M. C. Hinderlider in 1903:

August 22: Gage height, 1.30 feet; discharge, 7 second-feet.

No other measurements were secured in 1903 on account of the extremely low stage of this stream during the entire year. For the same reason but one discharge measurement was made in 1904, which was made by George B. Monk:

October 12: Discharge, 137 second-feet.

This measurement was made after the great flood of September 29, 1904, which destroyed the gage. The gage will be reestablished in the spring of 1905.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Sapello River near Los Alamos, N. Mex., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.00	1.00	1.10	1.00	1.30	1.00
2	.....	1.00	1.00	1.10	1.00	1.30	1.00
3	.....	1.00	1.00	1.10	1.00	2.30	1.00
4	.....	1.00	1.00	1.10	1.00	2.20	1.00
5	.....	1.00	1.00	1.10	1.00	1.95	1.00
6	1.00	1.00	1.00	1.10	1.00	2.75	1.00
7	1.00	1.00	1.00	1.10	1.00	2.20	1.00
8	1.00	1.00	1.00	1.10	1.00	2.30	1.00
9	1.00	1.00	1.00	1.10	1.00	2.40	1.00
10	1.00	1.00	1.00	1.10	1.00	2.30	1.00
11	1.00	1.00	1.00	1.10	1.00	1.70	1.00
12	1.00	1.00	1.00	1.35	1.00	1.25	1.00
13	1.00	1.00	1.00	2.55	1.00	1.00	1.00
14	1.00	1.00	1.00	3.20	1.00	1.00	1.00
15	1.00	1.00	1.00	2.40	1.00	1.00	1.00
16	1.00	1.00	1.00	2.55	1.00	1.00	1.00
17	1.00	1.00	1.00	2.60	1.00	1.00	1.00
18	1.00	1.00	1.00	1.35	1.00	2.25	1.00
19	1.00	1.00	1.10	1.20	1.00	1.30	1.00
20	1.00	1.00	1.10	1.05	1.00	1.00	1.00
21	1.00	1.00	1.20	1.00	1.00	1.00	1.00
22	1.00	1.00	2.70	1.00	1.00	1.00	1.00
23	1.00	1.00	2.15	1.00	1.95	1.00	1.00
24	1.00	1.00	1.40	1.00	2.10	1.00	1.00
25	1.00	1.00	1.15	1.00	1.65	1.00	1.00
26	1.00	1.00	1.10	1.00	1.80	1.00	1.00
27	1.00	1.00	1.10	1.00	2.05	1.00	1.00
28	1.00	1.00	1.10	1.00	1.50	1.00	5.90
29	1.00	1.00	1.10	1.00	1.30	1.00	(a)
30	1.00	1.00	1.10	1.00	1.30	1.00	.....
31	1.00	.....	1.10	.....	1.30	1.00	.....

a Gage destroyed by flood.

SAPELLO MILL TAILRACE AT SAPELLO, N. MEX.

A gage rod was placed in the mill tailrace of the flouring mill at Sapello, for the purpose of determining the amount of water passing through the mill wheel. This water is diverted by two ditches from both Sapello and Manuelitos rivers at points above the gage rods in those streams, and reenters Sapello River below the junction of Sapello and Manuelitos rivers. At low stages these ditches take the entire supply in the two rivers before the water reaches the gage rods in the same, and as this water is returned to the river below the gage rods through the mill tailrace it was necessary to place a gage in the mill tailrace. This gage consists of a 2 by 4 inch by 5-foot timber graduated to vertical feet and tenths and placed in the mill tailrace about 150 feet below the mill. The amount of water passing this gage, added to the amount passing the gages in Sapello and Manuelitos rivers, gives the total discharge of the Sapello proper. This station, with the sta-

tions on the Sapello and Manuelitos rivers at Sapello, was abandoned in March, 1904.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Sapello Mill tailrace at Sapello, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	0.30	0.30	0.80	12	0.30	0.30	0.30	23	0.30	0.80	0.40
2	.30	.30	.80	13	.30	.30	.30	24	.30	.90	.00
3	.30	.30	.80	14	.30	.30	.00	25	.30	.90	.00
4	.30	.30	.80	15	.30	.30	.00	26	.30	.90	.00
5	.30	.30	.80	16	.30	.30	.00	27	.30	.90	.20
6	.30	.30	.00	17	.30	.30	.00	28	.30	.90	.20
7	.30	.30	.00	18	.30	.30	.00	29	.30	.90	.20
8	.30	.30	.30	19	.30	.40	.00	30	.30	.....	.20
9	.30	.30	.30	20	.30	.50	.00	31	.30	.....	.20
10	.30	.30	.30	21	.30	.60	.00				
11	.30	.30	.30	22	.30	.60	.00				

MANUELITOS RIVER AT SAPELLO, N. MEX.

This station was established August 11, 1903, by E. G. Marsh. It is located two-fifths of a mile above the junction of Sapello and Manuelitos rivers, and about 12 miles from Las Vegas, N. Mex. There is a riprap wing dam 500 feet below the station. The gage is a 1 by 8 inch pine board 10 feet long, bolted in an inclined position to the rocky bluff on the left bank, and is graduated to read to vertical tenths of feet. It is read once each day by Horace R. Titlow. A cable, car, and tagged wire will be necessary in order to obtain measurements at high water. The initial point for soundings is a cross cut in the face of the rock 5 feet downstream from the gage, on the east bank. The channel is straight for 100 feet above and 250 feet below the station. At flood stages the current is very swift and there is but one channel. At very low water there are several small channels. The right bank is low, brush lined, and overflows at high water until it reaches a second higher bank. The left bank is a steep, rocky bluff, and does not overflow. The bed of the stream is composed of quicksand, which is prevented from shifting by the riprap dam below. The bench mark consists of two arrows cut in the rocky bluff 39 feet downstream from the gage. Its elevation is 7.65 feet above the zero of the gage. This station was abandoned in March, 1904, and replaced by the one on Sapello River at Los Alamos.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Manuelitos River at Sapello, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	0.30	0.40	0.30	12	0.30	0.40	0.30	23	0.30	0.30	0.30
2	.30	.40	.30	13	.30	.40	.30	24	.30	.30	.30
3	.30	.40	.30	14	.30	.30	.30	25	.30	.30	.30
4	.30	.40	.30	15	.30	.30	.30	26	.30	.30	.30
5	.30	.40	.30	16	.30	.30	.30	27	.30	.30	.30
6	.30	.40	.30	17	.30	.30	.30	28	.30	.30	.30
7	.30	.40	.30	18	.30	.30	.30	29	.30	.30	.30
8	.30	.40	.30	19	.30	.30	.30	30	.30	.30	.30
9	.30	.40	.30	20	.30	.30	.30	31	.30	.30	.30
10	.30	.40	.30	21	.30	.30	.30				
11	.30	.40	.30	22	.30	.30	.30				

UTE CREEK NEAR LOGAN, N. MEX.

This station was established August 12, 1904, by W. G. Russell. It is located about 7 miles northwest of Logan, N. Mex., and about 4 miles above the mouth of Ute Creek, near the old Martinez house. An inclined staff gage, graduated to read in vertical feet and tenths from zero to 7 feet, is fastened to the point of rocks about 100 yards northwest of the old Martinez house. The graduations are continued up to 11 feet on the rock. The gage is read once each day by Manuel Martinez. Discharge measurements are made at low water by wading near the gage. Discharges for high stages must be computed from the slope and cross section. The initial point for soundings is at the gage, on the left bank of the stream. The channel is straight for about 300 feet above the station. The current is sluggish at low and swift at high stages. The right bank is low, clean, and subject to overflow. The left bank is high, rocky, wooded, and does not overflow. The bed of the stream is composed of clean sand, and is shifting. There is but one channel at all stages. The bench mark is a cross painted on the top of a rock on the left bank, 100 feet below the gage. Its elevation is 5.51 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Mean daily gage height, in feet, of Ute Creek near Logan, N. Mex., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.50	0.10	0.10	17	5.50	0.40	0.30	0.10	0.20
2	.....	9.00	2.20	.10	.10	18	2.30	.40	.30	.10	.20
3	.....	5.50	2.00	.10	.10	19	2.10	.30	.30	.10	.20
4	.....	3.50	1.60	.10	.10	20	1.30	.30	.20	.10	.20
5	.....	2.00	1.30	.10	.20	21	1.20	.30	.20	.10	.20
6	.....	1.10	1.00	.10	.20	22	1.10	.30	.20	.10	.20
7	.....	.80	.80	.10	.30	23	1.00	.30	.20	.10	.20
8	.....	.50	.50	.10	.30	24	.90	.30	.20	.10	.20
9	.....	.40	1.00	.10	.30	25	.80	.20	.20	.10	.20
10	.....	.20	.90	.10	.30	26	.70	.20	.10	.10	.20
11	.....	.30	.90	.10	.30	27	.60	.20	.10	.10	.20
12	.....	.40	.80	.10	.20	28	(a)	3.50	.10	.10	.20
13	.....	.40	.70	.10	.20	29	.....	5.00	.10	.10	.20
14	0.30	.40	.50	.10	.20	30	.....	3.00	.10	.10	.20
15	.30	.40	.30	.10	.20	31	.....	.....	.10	.....	.20
16	.30	.40	.30	.10	.20						

a Creek dry August 28 to September 1, inclusive.

BEAVER CREEK NEAR BEAVER, OKLA.

This station was established March 29, 1904, by W. G. Russell. It is located just below the ford about one-fourth mile north of Beaver, Okla. The gage is an inclined 1 by 4 inch rod 12 feet long, graduated to feet and tenths from zero to 5.5 feet, spiked to two locust fence posts driven 5 feet into the right bank and bed of the river. It is read once each day by Logan Rock. Discharge measurements are made at low water by wading. It is not possible to make high-water measurements in this vicinity, and the discharge during floods must be computed from the slope and cross section. The initial point for soundings is at the gage. The channel is straight for about 300 feet above and below the station and about 95 feet wide at ordinary stages. During the flood of July, 1904, the river was 2,547 feet wide along the highway and across the ford, and the stream bed was eroded. The old gage was destroyed July 9, 1904, and a new one was placed a short distance downstream at the same elevation. The current is sluggish at low water, but has a good current at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages. The bench mark is the top of a pine stake about 0.5 feet above the surface of the ground 15 feet south of the gage. Its elevation is 5.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements on Beaver Creek near Beaver, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 29	W. G. Russell	55	23	0.91	1.15	21
August 3	do	95	77	1.77	.82	[a]136

[a] Old gage destroyed July 9, 1904, and new gage was placed a short distance downstream at the same elevation. The flood cut the bed out and left water surface at lower elevation.

Mean daily gage height, in feet, of Beaver Creek near Beaver, Okla., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.10	1.50	1.10	1.50	.....	0.40	0.70	0.75	0.75
2	.....	1.15	1.60	1.10	1.30	.....	.35	2.60	.75	.75
3	.....	1.15	2.60	1.15	1.30	0.80	.35	3.15	.75	.75
4	.....	1.20	2.40	1.10	1.50	.70	.35	2.00	.70	.75
5	.....	1.20	1.80	1.10	1.50	1.90	.35	1.70	.75	.75
6	.....	1.25	1.60	1.15	1.40	1.40	.40	1.80	.75	.60
7	.....	1.25	1.50	1.10	4.10	1.10	.35	1.15	.75	.60
8	.....	1.25	1.85	1.10	4.80	.90	.35	1.15	.75	.65
9	.....	1.25	1.30	2.17	.....	.70	.35	1.00	.70	.65
10	.....	1.20	1.30	1.90	.....	.65	.35	.90	.70	.65
11	.....	1.20	1.35	1.50	.....	.60	.40	.90	.70	.70
12	.....	1.15	1.30	1.40	.....	1.40	.40	.85	.70	.70
13	.....	1.15	1.20	1.35	.....	1.10	.90	.75	.70	.90
14	.....	1.15	1.20	1.30	.....	1.05	.90	.65	.70	.90
15	.....	1.15	1.20	1.25	.....	.90	.80	1.50	.70	.90
16	.....	1.15	1.20	1.20	.....	.95	.70	1.40	.65	.90
17	.....	1.10	1.20	1.15	.....	.55	.50	1.30	.65	1.00
18	.....	1.10	1.15	1.10	.....	.60	.45	1.30	.65	.95
19	.....	1.10	1.10	1.10	.....	.60	.30	1.25	.65	.90
20	.....	1.15	1.10	2.30	.....	.55	.30	1.00	.65	.90
21	.....	1.10	1.10	1.40	.....	.90	.30	1.00	.70	.85
22	.....	1.10	1.10	1.20	.....	1.10	.25	.95	.65	.85
23	.....	1.10	1.10	1.20	.....	.80	.25	.90	.65	.80
24	.....	1.10	1.10	1.30	.....	.75	.30	.90	.65	.80
25	.....	1.10	1.10	1.30	.....	.70	.30	.90	.65	.80
26	.....	1.15	1.10	1.25	.....	.60	.30	.85	.65	.80
27	.....	1.15	1.15	1.30	.....	.55	.30	.80	.70	.80
28	.....	1.10	1.15	1.40	.....	.50	.25	.80	.70	.80
29	1.15	1.20	1.15	1.70	.....	.40	.25	.75	.75	.90
30	1.15	1.25	1.10	1.70	.....	.40	.30	.75	.75	1.00
31	1.10	.....	1.10	.....	.....	.45	.....	.75	.....	1.10

CANADIAN RIVER (NORTH FORK) NEAR WOODWARD, OKLA.

This station was established September 13, 1903, by W. G. Russell. It is located 7 miles east of Woodward, at the railroad bridge. The gage is painted on the west face of the second pier from the west end of the bridge. It reads from zero to 7 feet. The observer is Adolph Mueller, the section foreman. Discharge measurements are made from the six-span railroad bridge, which has a total length between abutments of 360 feet. The initial point for soundings is the west end

of the bridge. The channel is straight for 200 feet above and below the station. The right bank is high and not liable to overflow. The left bank is low and liable to overflow, with scattering trees along the bank. The bed of the stream is sandy and shifting. There is one channel, broken by two piers at low water and five piers at high water. The bench mark is the bottom of the coping stone of the pier at the top of the gage. Its elevation is 7.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

Discharge measurements of Canadian River (North Fork) near Woodward, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
August 18	W. G. Russell	140	263	0.98	2.20	258
September 18	do	82	41	1.85	1.70	76

Mean daily gage height, in feet, of Canadian River (North Fork) near Woodward, Okla., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.50	2.60	2.60	2.40	5.00	2.00	2.20	.....	2.00	1.70	2.10	2.10
2	2.40	2.60	2.60	2.30	3.20	2.00	2.40	.....	2.00	1.90	2.10	2.10
3	2.50	2.50	2.60	2.40	3.00	2.00	2.30	.....	2.00	1.90	2.10	2.10
4	2.50	2.70	2.50	2.40	7.00	2.00	2.30	.....	1.80	3.70	2.10	2.20
5	2.50	2.80	2.60	2.50	3.60	2.00	2.50	.....	1.80	2.90	2.10	2.20
6	2.50	2.70	2.60	2.40	3.50	2.00	2.50	.....	1.70	2.70	2.10	2.40
7	2.50	2.60	2.50	2.40	3.40	2.00	3.00	.....	1.60	2.70	2.10	2.50
8	2.50	2.70	2.50	2.40	3.00	2.00	7.80	.....	1.60	2.60	2.10	2.40
9	2.40	2.70	2.50	2.40	2.90	2.00	7.70	.....	1.60	2.40	2.10	2.40
10	2.60	2.60	2.50	2.40	2.70	2.30	7.00	.....	1.60	2.40	2.10	2.40
11	2.70	2.50	2.50	2.40	2.50	4.50	4.50	.....	1.50	2.40	2.10	2.40
12	2.50	2.50	2.50	2.40	2.40	3.70	4.00	.....	2.00	2.30	2.10	2.40
13	2.60	2.50	2.50	2.40	2.40	3.20	3.50	.....	1.90	2.30	2.10	2.40
14	2.50	2.90	2.50	2.40	2.30	3.00	3.00	.....	1.90	2.20	2.10	2.40
15	2.50	2.60	2.50	2.40	2.30	2.70	3.00	.....	1.80	2.20	2.10	2.40
16	2.50	2.60	2.50	2.30	2.60	2.60	3.00	.....	1.80	2.10	2.10	2.40
17	2.70	2.80	2.50	2.20	2.60	2.60	2.80	.....	1.80	2.10	2.10	2.40
18	2.60	2.30	2.40	2.20	2.60	2.60	2.80	.....	1.70	2.10	2.10	2.20
19	2.50	2.70	2.50	2.20	2.60	2.30	2.60	.....	1.70	2.10	2.10	2.10
20	2.50	2.60	2.60	2.30	2.10	2.30	2.60	.....	1.80	2.10	2.10	2.20
21	2.50	2.90	2.50	2.30	2.30	2.30	2.40	2.30	1.80	2.10	2.10	2.40
22	2.50	2.70	2.50	2.20	2.20	2.10	2.70	2.30	1.80	2.10	2.10	2.60
23	2.50	2.70	2.50	2.20	2.00	2.30	2.60	2.70	1.80	2.10	2.10	2.50
24	2.50	2.70	2.50	2.20	2.10	2.40	2.50	2.50	1.80	2.10	2.10	2.40
25	2.60	2.70	2.50	2.20	2.60	2.30	2.40	2.40	1.80	2.10	2.10	2.30
26	2.40	2.70	2.40	2.20	2.10	2.30	2.40	2.30	1.80	2.10	2.10	2.30
27	2.50	2.60	2.40	2.20	2.10	2.50	2.50	2.20	1.70	2.10	2.10	2.30
28	2.50	2.70	2.40	2.20	2.10	2.40	2.50	2.30	1.70	2.10	2.10	2.30
29	2.60	2.60	2.40	2.20	2.10	2.40	2.40	2.20	1.70	2.10	2.10	2.30
30	2.60	.....	2.40	2.40	2.10	2.40	2.30	2.20	1.70	2.10	2.10	2.30
31	2.70	.....	2.40	.....	2.10	.....	.....	2.20	.....	2.10	.....	2.30

CANADIAN RIVER (NORTH FORK) NEAR EL RENO, OKLA.

This station was established October 27, 1902, by W. G. Russell, and is located at the highway bridge, 2 miles north of El Reno, Okla. The gage is of the usual wire type, with a scaleboard graduated to feet and tenths, and nailed to the railing of the bridge. The distance from the end of the weight to the marker is 17.06 feet. The bench mark is the top of a steel cylinder on the north side of the bridge. Its elevation is 11.30 feet above the zero of the gage. The initial point for soundings is on the right bank. The channel both above and below the station is straight for about 200 feet and has a width of 30 feet. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and somewhat shifting. The observer is Kenneth A. Killion, who reads the gage once daily. The gage was destroyed July 6, 1903, but was reestablished July 10.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

Discharge measurements of Canadian River (North Fork) near El Reno, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 24 [a]	E. R. Kerby	101	101	0.65	2.80	66
May 4	do	106	244	2.25	4.10	547
June 7	do	101	109	1.73	2.90	187
July 24	do	116	677	2.60	6.55	1,764
August 31	do	68	101	1.85	3.10	184
September 21	do	53	55	1.63	2.60	89
October 18	do	59	88	1.63	3.00	143

[a] Float measurement.

Mean daily gage height, in feet, of Canadian River (North Fork) near El Reno, Okla., for 1904.

Day.	Jan.[a]	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.90	2.00	2.30	2.00	2.40	2.80	2.80	3.90	3.00	2.30	2.60	2.60
2	1.80	2.00	2.30	2.00	2.30	2.70	2.80	3.60	3.00	2.30	2.70	2.60
3	1.80	2.00	2.30	2.00	3.50	5.70	5.10	3.70	2.90	2.40	2.70	2.60
4	1.80	2.00	2.30	2.00	4.10	6.00	3.80	3.60	2.90	2.80	2.70	2.60
5	1.80	2.00	2.30	2.00	7.90	3.90	3.20	3.60	2.80	2.60	2.70	2.60
6	1.80	2.10	2.30	2.00	8.60	3.40	3.10	3.50	2.80	2.40	2.70	2.50
7	1.80	2.00	2.20	2.00	8.90	2.90	2.90	3.60	2.80	2.30	2.70	2.50
8	1.80	2.20	2.20	2.00	5.70	3.00	2.90	3.50	2.70	2.30	2.60	2.50
9	1.90	2.20	2.20	2.00	5.30	2.80	8.40	3.60	2.60	5.60	2.60	2.50
10	1.90	2.20	2.10	2.00	4.90	4.60	9.15	3.60	2.60	3.80	2.60	2.50
11	1.90	2.30	2.10	2.00	4.60	5.80	9.30	4.10	2.60	3.60	2.60	2.70
12	1.80	2.30	2.10	1.90	4.30	6.95	9.35	4.00	2.70	3.40	2.60	2.70
13	1.90	2.30	2.10	1.90	3.90	6.30	9.40	4.60	2.70	3.20	2.60	2.70
14	1.90	2.20	2.10	1.80	3.90	5.00	9.50	4.80	2.70	3.20	2.60	2.60
15	1.90	2.20	2.10	1.90	3.60	4.80	10.00	4.20	2.60	3.10	2.60	2.60
16	1.90	2.30	2.10	1.80	4.00	4.50	8.70	3.90	2.60	3.10	2.60	2.60
17	2.00	2.30	2.10	1.80	3.60	4.10	6.70	3.80	2.60	3.00	2.60	2.60
18	2.10	2.30	2.10	1.80	3.60	3.80	5.70	3.60	2.60	2.90	2.60	2.80
19	2.10	2.30	2.10	1.80	3.50	3.50	5.50	3.40	2.50	2.90	2.60	2.70
20	2.10	2.30	2.00	1.80	3.40	3.40	5.00	3.40	3.10	2.80	2.60	2.80
21	2.20	2.30	2.00	1.80	3.20	3.10	4.90	3.30	2.60	2.80	2.70	2.90
22	2.20	2.20	2.00	1.80	3.20	3.10	4.60	3.40	2.70	2.70	2.60	2.90
23	2.20	2.20	2.00	1.80	3.10	3.00	4.50	3.40	2.60	2.70	2.60	2.90
24	2.20	2.20	2.00	1.80	3.00	2.90	6.50	3.80	2.60	2.70	2.60	2.90
25	2.10	2.20	2.00	4.00	3.00	2.80	5.60	3.70	2.50	2.80	2.60	3.00
26	2.10	2.20	2.00	3.60	2.80	4.00	4.50	3.50	2.50	2.80	2.60	3.30
27	2.10	2.30	2.00	3.00	2.80	3.00	4.40	3.50	2.40	2.70	2.60	3.20
28	2.10	2.30	2.00	2.60	2.80	3.10	4.10	3.50	2.40	3.00	2.60	3.20
29	2.00	2.30	2.00	2.60	2.80	3.00	4.00	3.50	2.40	2.90	2.60	3.20
30	2.00	.....	2.00	2.60	2.80	2.80	4.00	3.20	2.30	2.70	2.60	3.20
31	2.00	.....	2.00	.....	3.20	.....	3.80	3.10	.....	2.60	.....	3.00

[a] River partly frozen during January.

Rating table for Canadian River (North Fork) near El Reno, Okla., from October 27, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	1	2.80	120	4.30	632	6.40	1,690
1.40	3	2.90	138	4.40	676	6.60	1,800
1.50	7	3.00	159	4.50	720	6.80	1,910
1.60	11	3.10	183	4.60	765	7.00	2,030
1.70	15	3.20	210	4.70	810	7.20	2,150
1.80	20	3.30	240	4.80	855	7.40	2,270
1.90	25	3.40	273	4.90	900	7.60	2,390
2.00	31	3.50	309	5.00	950	7.80	2,510
2.10	38	3.60	347	5.20	1,050	8.00	2,630
2.20	46	3.70	386	5.40	1,150	8.50	2,950
2.30	55	3.80	425	5.60	1,250	9.00	3,300
2.40	65	3.90	465	5.80	1,360	9.50	3,650
2.50	76	4.00	506	6.00	1,470	10.00	4,000
2.60	89	4.10	547	6.20	1,580		
2.70	104	4.20	589				

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.3 feet and 4.1 feet. The curve above gage height 4.1 feet is determined by one measurement at gage height 6.55 feet.

Estimated monthly discharge of Canadian River (North Fork) near El Reno, Okla., for 1902, 1903, and 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1902.				
October 27–31	31	31	31	.....
November	291	31	67.6	4,022
December	120	65	88.3	5,429
1903.				
January	159	76	128	7,870
February	347	120	157	8,719
March	1,050	183	464	28,530
April	347	120	207	12,320
May	3,510	159	1,196	73,540
June	1,150	210	487	28,980
July 26 days[a]	309	20	72.7	3,749
August[b]	138	7	28.9	1,777
September	11	0	3.37	201
October	11	0	1.77	109
November	7	1	2.47	147
December	25	1	10.3	633
The period	3,510	0	.....	166,600
1904.				
January[c]	46	20	30.1	1,851
February	55	31	46.3	2,663
March	55	31	39.4	2,423
April	506	20	63.2	3,761
May	3,230	55	622	38,240
June	2,000	104	530	31,540
July	4,000	120	1,421	87,370
August	855	183	381	23,430
September	159	55	101	6,010
October	1,250	55	176	10,820
November	104	89	92.5	5,504
December	240	76	122	7,501
The year	4,000	20	302	221,100

[a] Gage out 5 days in July.
[b] Discharge interpolated August 2 to 10.
[c] River partly frozen during January. Rating table applied as for open channel.

GREER SPRING AT GREER, MO.

Greer Spring is located in the north-central part of Oregon County, 1½ miles south of Eleven Point River, near the town of Greer. Ordinarily it derives one-fourth of its water supply from an underground stream emerging from a cave in a high limestone bluff; the remainder from the so-called "boil," 100 feet distant and 7 feet lower, the source of which is unknown. The whole rises at the head of a deep and narrow valley, and flows in rapid descent to Eleven Point River, a distance of 1½ miles. On September 30, 1904, levels were run from the cave exit of the spring to Eleven Point River, and an almost uniform fall of 53.94 feet was found. There are numerous points at which dams could be built, affording solid rock for foundations and abutment, with plenty of material for building close at hand. There is at present a stone and timber dam, developing a fall of 9 feet and transmitting the power to a gristmill above the valley. On August 9, 1904, a gage was established by F. W. Hanna. Bench mark No. 1 is the top of a staple in a large root on the upstream side of a walnut tree, 10 feet upstream from left end of footbridge, which is 100 feet below the present dam. Its elevation is 9.96 feet above gage datum. Bench mark No. 2 is the top surface of the support of the right end of the footbridge, 1½ feet from the downstream end on the right side. Its elevation is 3.93 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

Discharge measurements of Greer Spring at Greer, Mo., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
August 29	F. W. Hanna	1.00	362
October 1	Johnson and Hanna	.72	265

Mean daily gage height, in feet, of Greer Spring at Greer, Mo., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.95	.....	0.65	0.60	17	1.00	.....	0.65	0.60	0.60
2	.....	.95	.....	.65	.60	18	1.00	.....	.65	.60	.60
3	.....	.95	.....	.65	.60	19	1.00	.....	.65	.60	.60
4	.....	.95	.....	.65	.60	20	1.00	.....	.65	.60	.60
5	.....	.95	.....	.60	.60	21	1.00	.....	.65	.60	.60
6	.....	.95	.....	.60	.60	22	1.00	.....	.65	.60	.60
7	.....	.95	.....	.60	.60	23	1.00	.....	.65	.60	.60
8	.....	.95	.....	.60	.60	24	1.00	.....	.....	.60	.60
9	.....	.95	.....	.60	.60	25	1.00	.....	.....	.60	.60
10	1.00	.95	.....	.60	.60	26	1.00	.....	.....	.60	.60
11	1.00	.....	.....	.60	.60	27	1.00	.....	.....	.60	.60
12	1.00	.....	.....	.60	.60	28	1.00	.....	.....	.60	.60
13	1.00	.....	0.70	.60	.60	29	.95	.....	.65	.60	.60
14	1.00	.....	.70	.60	.60	30	.95	.....	.65	.60	.60
15	1.00	.....	.70	.60	.60	31	.95	.....	.65	.....	.60
16	1.00	.....	.65	.60	.60						

MISCELLANEOUS MEASUREMENTS IN ARKANSAS RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Arkansas River drainage basin in 1904 under the direction of the State engineer:

Discharge measurements of Arkansas River at Canyon City, Colo., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
March 16	A. A. Weiland	4.00	496
March 19	do	3.37	203
April 14	do	3.72	378
April 18	do	4.20	611
April 18	do	4.07	578
April 25	do	4.03	494
April 26	do	3.60	275
May 16	do	4.00	496
May 18	do	4.48	799
June 7	do	4.80	965
June 10	do	5.20	1,307
June 29	do	4.80	924
June 29	do	4.26	569

Discharge measurements of Arkansas River at Pueblo, Colo., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
March 25	A. Jones	1.70	97
April 7	do	1.97	216
April 12	A. A. Weiland	2.15	87
April 18	A. Jones	2.60	468
May 4	A. A. Weiland	2.68	745
May 9	A. Jones	2.89	792
May 15	do	3.50	1,554
May 26	do	3.70	2,178
May 31	do	3.43	1,677
June 7	do	2.98	1,040
June 9	do	3.73	2,091
July 1	A. A. Weiland	3.39	1,620
August 17	do	3.50	1,910
August 27	do	2.94	1,004
September 16	do	2.19	354
September 26	do	2.24	359

Discharge measurements of Arkansas River at Nepesta, Colo., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 14	A. Jones	72	1.49	0.49	107
April 11	do	70	1.64	.40	115
May 4	A. A. Weiland	467	2.55	1.10	1,193
May 18	A. Jones	345	3.00	1.02	1,024
June 6	do	779	2.62	1.40	2,067

Discharge measurements of Arkansas River at La Junta, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 31	A. Jones	40	28	1.28	1.51	36
May 10	do	145	419	.89	2.40	370
May 16	do	97	180	2.49	2.70	449
May 23	do	143	344	1.47	2.55	505
June 1	do	158	239	2.23	2.63	534

Discharge measurements of Arkansas River at Prowers, Colo., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 6	A. Jones	711	1.86	0.87	1,319
May 22	do	2,127	4.70	2.90	10,000

Measurements in Cimarron River drainage basin in 1904.

[By L. M. Holt and Claud Fisher.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
Mar. 20	Cimarron River	Kenton, Okla	2	1.12	1.2	1.38
Mar. 23	do	do	2	1.12	1.4	1.6
Mar. 30	Colonel Perry's irrigation ditch	Englewood, Kans.	4.4	6.07	1.7	10.7
Mar. 31	Cimarron River	Coin, Okla	56	47	1.8	84

Measurements in Canadian River drainage basin in 1904.

[By Elmas R. Kerby.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
Jan. 23	Canadian River	Union City, Okla	45	34	1.10	38
June 7	do	do	219	304	1.55	472
Oct. 16	do	do	1,240	3,414	2.64	9,009
Jan. 23	Deer Creek	Hydro, Okla	20	16	1.32	22
May 4	do	do	23	37	2.29	85
June 8	do	do	24	21	1.49	31

Measurements in Arkansas River drainage basin in 1904.

[By M. R. Hall and assistants.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 27	White River.	Near Newport, Ark.	472	12,870	3.24	16.7	41,630

NOTE.—Measured at Iron Mountain Railroad bridge, about 2 miles southwest of Newport. Gage height from United States Weather Bureau gage.

RED RIVER DRAINAGE BASIN.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low, swampy region in Louisiana into the Mississippi, not far from the southern boundary of Mississippi. Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming the boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the boundary line between that State and Louisiana. The flow of this river is very unreliable, changing with the rainfall. If the summer is at all dry it ceases to flow altogether, but there always remains enough water standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress River has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases to flow, becoming dry, except in those places where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

RED RIVER (NORTH FORK) NEAR GRANITE, OKLA.

This station was established June 23, 1903, by Ferd. Bonstedt. It is located at the highway bridge 2 miles east and one-half mile north of Granite, Okla. The Chicago, Rock Island and Pacific Railroad crosses the river near this point. The gage is of the wire type and is located on the downstream side of the bridge near the west end. The length from the bottom of the weight to the marker is 20.32 feet. The marker reads 17.00 feet when the weight is pulled up against the bottom of the bridge. The gage is read daily by Elmer O. Tompkins. Discharge measurements are made from the bridge. The channel is straight for about 500 feet above the station and for about 300 feet below. Both banks are subject to overflow at flood stages. The bed of the stream is sandy and shifting. The water flows in three channels at low water. The gage is referred to a United States Geological Survey standard iron bench mark which is 292 feet east of the bridge

near the south line of the highway. Its elevation above gage datum is 10.64 feet and above sea level 1,539.8 feet.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

Discharge measurements of Red River (North Fork) near Granite, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 6	E. R. Kerby	120	171	1.35	4.90	231
May 26	do	2	0.4	0.30	3.50	.12
June 9	do	281	1,081	1.91	6.20	2,062
July 13	do	32	34	1.54	5.10	49
August 30	do					[a].0
September 22	do					[a].0
October 21	do					[a].0

[a] Water standing in pools.

Mean daily gage height, in feet, Red River (North Fork) near Granite, Okla., for 1904.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1		4.5	5.0		17	4.1	4.7	4.7	
2		4.3	5.0		18	4.0	4.5	4.6	
3	6.6	4.3	4.8		19	3.9	4.5	4.5	
4	7.0	4.0	6.5		20	3.9	4.4	4.5	
5	5.5	3.9	6.0	5.2	21	3.8	7.8	4.5	
6	4.9	4.1	5.7	5.6	22	3.8	5.8	4.5	
7	4.6	4.3	5.5	5.5	23	3.7	5.2	4.5	
8	4.5	4.1	5.5	5.4	24	3.6	6.0	4.5	
9	4.5	7.2	5.5	5.1	25	3.6	5.0	4.5	
10	4.4	6.4		5.1	26	3.5	5.5		
11		6.0		4.8	27	3.6	5.5		
12	4.3	6.8	5.2	4.7	28	3.9	5.4		
13	4.3	5.1	5.1	4.6	29	4.0	5.2		
14	4.3	5.0	5.0		30	5.1	5.1		
15	4.2	4.9	4.9		31	4.7			
16	4.1	4.8	4.8						

NOTE.—No discharge except on days when gage heights are given.

ELK CREEK NEAR HOBART, OKLA.

This station was established September 22, 1904, by Elmas R. Kerby. It is located about 3 miles southwest of Hobart, Okla., 300 feet north of public highway running west, and 450 feet upstream from a small temporary bridge across the creek. The gage is a plain staff, graduated to feet and tenths, fastened to a large cottonwood tree on the right bank. The gage is read once each day by A. P. Lockhart. Discharge measurements are made at low stages by wading 100 feet

below the gage. During high water, measurements are made from the bridge. A permanent bridge is to replace the temporary one, so no initial point for soundings has been selected. The channel is straight for about 100 feet above and below the station. The current varies, being swift in some places and sluggish in others. Both banks are high and wooded. The bed of the stream is free from vegetation, and is permanent. There is but one channel at all stages. The bench mark is a screw in the base of a large cottonwood tree on the left bank of the stream about 80 feet south of the gage. The tree is blazed on the east and south sides, and located about 120 feet north from the center of the public highway. The elevation of the bench mark is 17.23 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

Discharge measurements of Elk Creek near Hobart, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
September 22 ..	Gordon and Kerby.....	6.4	2.9	0.61	0.90	1.8
October 21.....	Kerby and Johnson	7.3	4.3	.69	.95	3.0

Mean daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1.....	.....	0.9	1.0	1.8	17.....	.....	1.1	1.5	1.8
2.....	.....	.9	1.0	1.8	18.....	.....	1.1	1.5	1.8
3.....	.....	.9	1.0	1.8	19.....	.....	.9	1.5	1.9
4.....	.....	.9	1.0	1.8	20.....	.....	.9	1.5	1.9
5.....	.....	.9	1.0	1.5	21.....	.....	.9	1.5	1.9
6.....	.....	.9	1.0	1.5	22.....	0.9	.9	1.6	2.0
7.....	.....	.9	1.0	1.5	23.....	1.0	.9	1.7	2.0
8.....	.....	.9	1.0	1.6	24.....	1.0	.9	1.7	1.9
9.....	.....	.9	1.0	1.6	25.....	1.0	.9	1.7	1.9
10.....	.....	.9	1.0	1.7	26.....	1.0	.9	1.7	1.9
11.....	.....	.9	1.1	1.8	27.....	.9	.9	1.7	1.9
12.....	.....	.9	1.2	1.8	28.....	.9	.9	1.7	1.9
13.....	.....	.9	1.3	1.8	29.....	.9	.9	1.8	1.9
14.....	.....	1.3	1.4	1.9	30.....	.9	.9	1.8	1.9
15.....	.....	.9	1.5	1.9	31.....	.....	.9	.....	1.9
16.....	.....	1.5	1.5	1.8					

OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 2, 1903, by G. H. Matthes. It is located on G. M. Dale's homestead, SE. ¼, sec. 21, T. 3 N., R. 17 W., Indian meridian. It is 2 miles west and 1 mile north of Mountain Park, Okla. The gage consists of a 2 by 6 inch board, 26 feet long, bolted to a cottonwood tree, which stands at the water's edge. It is graduated to feet and tenths and marked with brass figures. The gage is read daily by G. M. Dale. The channel is slightly curved both above and below the station. Both banks are about 20 feet high, of sandy loam, covered with vegetation, and subject to overflow. The bed of the stream is of sand, and is liable to shift. The water flows in one channel at normal stages, but when about to overflow its banks part of the water is diverted through a slough into Horse Creek. Measurements of discharge are made by wading, as there are no bridges in this locality. Bench mark No. 1 is a 20-penny nail driven into the cottonwood tree to which the gage is attached. It is at the elevation of the 10-foot mark on the gage. Bench mark No. 2 is a nail driven into a mesquite tree 150 feet southwest of G. M. Dale's house. It is 28.62 feet above the zero of the gage. Bench mark No. 3 is a nail driven into a hackberry tree 50 feet east of the creek and 20 feet north of the gage. It is 8.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

Discharge measurements of Otter Creek near Mountain Park, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 9	L. M. Holt	4	1.2	1.22	1.20	1.5
May 7	E. R. Kerby	11	4.4	.58	1.10	2.5
May 27	do	1	.1	1.00	.90	.1
July 14	do	1	.1	1.00	.90	.1
August 28	do				.90	[a].0
September 23	do				.90	[a].0
October 22	do				.90	[a].0

[a] Water standing in pools.

Mean daily gage height, in feet, of Otter Creek near Mountain Park, Okla., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.4	1.2	1.2	1.0	0.9	1.2	0.8	0.9	0.9	.9	0.9
2	1.4	1.4	1.2	1.2	1.0	.9	1.1	1.1	.9	.9	.9	.9
3	1.4	1.4	1.2	1.2	1.2	3.0	1.0	1.1	.9	.9	.9	.9
4	1.4	1.4	1.2	1.2	1.4	1.4	1.0	.9	.9	.9	.9	.9
5	1.4	1.3	1.2	1.5	1.3	1.2	1.0	3.2	.9	.9	.9	.9
6	1.4	1.3	1.2	1.2	1.2	1.1	1.0	2.1	.9	.9	.9	.9
7	1.4	1.3	1.3	1.3	1.1	1.0	1.1	3.6	.9	.9	.9	.9
8	1.4	1.3	1.3	1.2	1.1	1.0	1.1	2.0	.9	.9	.9	.9
9	1.4	1.3	1.3	1.2	1.0	3.3	1.0	1.5	.9	.9	.9	.9
10	1.4	1.3	1.3	1.2	1.0	9.2	1.0	1.3	.9	.9	.9	.9
11	1.4	1.3	1.2	1.2	1.0	2.4	1.0	1.2	.9	.9	.9	.9
12	1.4	1.3	1.2	1.2	1.0	1.7	.9	1.1	.9	.9	.9	.9
13	1.3	1.3	1.2	1.1	1.0	1.5	.9	1.0	.9	.9	.9	.9
14	1.3	1.3	1.2	1.1	1.0	1.3	.9	1.0	.9	.9	.9	.9
15	1.4	1.3	1.2	1.1	1.0	1.2	.9	1.0	.9	.9	.9	.9
16	1.4	1.3	1.3	1.1	4.0	1.1	.9	.9	.9	.9	.9	.9
17	1.4	1.3	1.3	1.1	1.5	1.1	.9	.9	.9	.9	.9	.9
18	1.4	1.3	1.2	1.1	1.3	1.0	.9	.9	.9	.9	.9	.9
19	1.4	1.3	1.2	1.1	1.2	1.0	.9	.9	.9	.9	1.0	.9
20	1.4	1.3	1.2	1.1	1.2	1.0	.9	.9	.9	.9	1.0	.9
21	1.5	1.3	1.2	1.1	1.0	1.0	1.25	.9	.9	.9	1.0	.9
22	1.5	1.3	1.2	1.1	1.0	1.0	1.1	.9	.9	.9	1.0	.9
23	1.4	1.3	1.2	1.1	1.0	1.0	1.0	.9	.9	.9	1.0	.9
24	1.4	1.3	1.2	1.1	.9	1.0	.9	.9	.9	.9	1.0	.9
25	1.4	1.3	1.2	1.1	.9	1.0	.9	.8	.9	.9	1.0	.9
26	1.4	1.3	1.2	1.1	.9	2.65	.9	.8	.9	.9	1.0	.9
27	1.4	1.3	1.2	1.0	.9	2.0	.9	.8	.9	.9	1.0	.9
28	1.4	1.3	1.2	1.0	.9	1.6	.9	.9	.9	.9	1.0	.9
29	1.4	1.3	1.2	1.0	1.5	1.4	.9	.9	.9	.9	0.9	.9
30	1.4	.....	1.2	1.0	1.3	1.3	.9	.9	.9	.9	0.9	.9
31	1.4	.....	1.2	.....	1.0	.....	.9	.9	.....	.9	.....	.9

Estimated monthly discharge of Otter Creek near Mountain Park, Okla., for 1904.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	3	2.0	2.50	154	0.020	0.023
February	2.5	2.0	2.07	118	.016	.017
March	2	1.5	1.60	98	.013	.015
April	3	1.0	1.35	80	.011	.012
May	188	.5	8.45	520	.067	.077
June	780	.1	40.1	2,386	.318	.355
July	1.8	0	.40	25	.0032	.0037
August	152	0	11.3	695	.090	.104
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	780	0	5.65	4,076	.045	.607

NOTE.—The monthly estimates are an approximation based on the 1903 rating tables and interpolation between the 1904 measurements.

WASHITA RIVER AT ANADARKO, OKLA.

This station, established October 25, 1902, by W. G. Russell, is located at the highway bridge one-half mile north of the Anadarko railroad depot. The gage is of the wire type, with the scaleboard graduated to feet and tenths, and spiked to the hand rail of the bridge. The initial point for soundings is on the right bank. The channel both above and below the station is straight for 200 feet; the right bank is high and the left bank is low; both banks are liable to overflow; the bed of the stream is sandy and constant. The observer is James H. Dunlap, who reads the gage once each day.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

Discharge measurements of Washita River at Anadarko, Okla., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 23	E. R. Kerby	65	108	1.24	3.40	134
May 3	do	70	308	1.84	5.40	566
May 25	do	68	147	2.16	3.60	318
June 6	do	72	287	1.79	5.10	513
July 12	do	73	909	3.12	13.60	2,850
July 23	do	70	220	2.12	4.60	466
August 30	do	76	148	1.28	3.30	190
September 20	do	63	92	1.16	2.70	94
October 19	do	56	96	.69	2.50	76

Mean daily gage height, in feet, of Washita River at Anadarko, Okla., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.3	3.3	3.2	5.8	4.0	4.1	3.9	3.0	2.5	2.3	2.5
2	3.3	3.3	3.3	3.2	6.1	4.4	3.7	3.8	2.9	2.4	2.3	2.5
3	3.3	3.3	3.3	3.2	5.4	5.0	3.5	4.1	2.8	2.4	2.3	2.5
4	3.3	3.3	3.3	3.2	4.9	4.7	3.4	4.3	2.8	2.4	2.3	2.5
5	3.3	3.3	3.3	3.3	4.1	7.1	3.1	4.7	2.8	2.4	2.3	2.5
6	3.3	3.3	3.3	3.3	6.8	5.1	3.1	5.9	2.8	2.4	2.3	2.5
7	3.3	3.3	3.3	3.4	9.6	4.9	3.1	8.9	2.8	2.4	2.3	2.5
8	3.3	3.3	3.3	3.4	10.1	4.6	3.1	6.4	2.8	2.4	2.4	2.5
9	3.3	3.3	3.3	3.4	5.9	5.6	3.1	5.9	2.8	2.4	2.4	2.5
10	3.3	3.3	3.3	3.3	5.6	5.3	9.7	4.1	2.8	2.4	2.4	2.5
11	3.3	3.3	3.3	3.3	5.0	7.6	12.2	4.6	2.8	2.4	2.4	2.5
12	3.3	3.3	3.3	3.2	4.7	9.6	13.6	4.2	2.8	2.4	2.4	2.5
13	3.3	3.3	3.3	3.2	4.2	10.4	14.1	4.0	2.8	2.3	2.4	2.5
14	3.3	3.3	3.2	3.2	3.9	9.7	14.6	3.9	2.7	2.3	2.4	2.5
15	3.3	3.3	3.2	3.2	3.7	6.8	13.1	3.8	2.7	2.3	2.4	2.5
16	3.3	3.3	3.2	3.2	4.8	5.6	7.8	3.8	2.7	2.4	2.4	2.5
17	3.3	3.3	3.2	3.2	5.7	4.7	6.4	3.7	2.7	2.4	2.4	2.5
18	3.3	3.3	3.2	3.2	7.3	4.2	6.0	3.6	2.7	2.4	2.4	2.5
19	3.3	3.3	3.2	3.2	7.6	4.0	5.5	3.5	2.7	2.5	2.4	2.5
20	3.3	3.3	3.2	3.2	6.8	3.9	5.2	3.4	2.7	2.4	2.4	2.6
21	3.5	3.3	3.2	3.2	4.9	3.8	4.9	3.4	2.6	2.4	2.4	2.6
22	3.4	3.3	3.2	3.3	4.3	3.6	4.7	3.3	2.6	2.4	2.5	2.6
23	3.4	3.3	3.2	3.4	3.9	3.5	4.6	3.2	2.6	2.3	2.5	2.6
24	3.4	3.3	3.2	3.4	4.6	3.4	4.5	3.1	2.6	2.3	2.5	2.6
25	3.4	3.3	3.2	3.4	3.6	3.3	4.6	3.1	2.6	2.3	2.5	2.6
26	3.4	3.3	3.2	3.4	3.5	3.6	4.7	3.1	2.6	2.3	2.5	2.6
27	3.4	3.3	3.2	3.6	3.2	4.3	4.9	3.2	2.6	2.3	2.5	2.6
28	3.3	3.3	3.2	5.1	3.2	4.7	4.4	3.1	2.5	2.3	2.5	2.6
29	3.3	3.3	3.2	4.9	3.2	5.9	4.2	3.1	2.5	2.3	2.5	2.6
30	3.3	.....	3.2	4.1	3.2	4.9	4.0	3.3	2.5	2.3	2.5	2.6
31	3.3	.....	3.2	.....	3.3	.....	4.0	3.0	.....	2.3	.....	2.6

Estimated monthly discharge of Washita River at Anadarko, Okla., 1902–1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1902.				
October 25–31	170	170	170	2,360
November	1,500	165	395	23,500
December	1,000	225	330	20,290
1903.				
January	205	160	177	10,880
February	1,920	140	312	17,330
March	2,760	311	666	40,950
April	551	228	314	18,680
May	7,500	311	1,815	111,600
June	3,110	699	1,210	72,000
July	720	230	376	23,120
August	220	95	159	9,777
September	94	55	70.3	4,183
October	82	65	75.0	4,612
November	103	73	88.4	5,260
December	105	92	101	6,210
The year	7,500	55	447	324,600
1904.				
January	147	103	119	7,317
February	117	117	117	6,730
March	117	102	108	6,641
April	511	102	148	8,807
May	1,766	215	569	34,990
June	1,856	196	588	34,990
July	3,180	164	792	48,700
August	1,420	148	335	20,600
September	148	74	105	6,248
October	76	46	55.5	3,413
November	74	46	60.9	3,624
December	118	74	80.8	4,968
The year	3,180	46	257	187,000

NOTE.—Discharges for 1902, 1903, and 1904 applied indirectly, taking into account periodic changes in channel between flood crests.

OUACHITA RIVER NEAR MALVERN, ARK.

This station is located at the fall line on the river, at the Rockport Bridge, 1¼ miles northwest of Malvern, Ark. The vertical gage, which is fastened to the web between the cylinders of the first pier from the left bank, was installed March 3, 1903, by the General Bauxite Company. It is read once daily by A. M. Baker. Discharge measurements are made from a three-span iron highway bridge 500 feet long and from 30 feet of trestle approach on the right bank, and the first was made by J. M. Giles, May 15, 1903, at which date bench marks were established. The initial point for soundings is the end of the iron bridge on the downstream side at the left bank. The channel is straight for 1,000 feet above and 800 feet below the station. The right bank is high and wooded and overflows only during extreme floods. The left bank does not overflow. The bed of the stream is composed mainly of rock and is permanent. An old dam just below the bridge is the cause of the sluggish current at low water. At this stage, however, measurements can be made by wading at gaps in the dam, where a good velocity may be obtained. Bench mark No. 1 is the top of the first cylindrical pier from the left bank on the downstream side. Its elevation is 27.08 feet above the zero of the gage. Bench march No. 2 is a copper plug set in the northwest corner of the left concrete abutment. Its elevation is 26.23 feet above the zero of the gage. Bench mark No. 3 is the top of an eyebolt set in the solid rock about 25 feet south of the bridge, at a point 90 feet from the initial point for soundings. Its elevation is 11.86 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. R. Hall, district hydrographer.

Discharge measurements of Ouachita River near Malvern, Ark., in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 15	J. M. Giles		2,471	1.77	5.60	4,395
May 16	do		2,252	1.53	5.00	3,455
July 9	do		421	.40	.65	171
July 9	do		172	1.15	.65	198
July 10	do		177	1.37	.80	243
1904.						
April 25	J. M. Giles	480	5,734	3.09	12.30	17,700
April 25	do	480	5,446	2.88	11.60	15,660
April 26	do	470	4,019	2.20	8.45	8,849
April 26	do	410	3,600	2.22	7.90	7,989

Mean daily gage height, in feet, of Ouachita River near Malvern, Ark.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.[a]	Nov.	Dec.
1	2.90	3.80	4.50	3.80	1.00	2.00	3.00	0.50	.....	.....	0.30
2	2.70	3.40	4.20	3.80	1.00	1.70	1.70	.50	.....	.....	.40
3	2.40	3.00	3.90	3.60	1.00	1.00	1.20	2.10	.....	.....	.20
4	2.30	2.90	3.50	3.00	.90	1.20	3.50	1.80	.....	.....	.10
5	2.20	2.80	3.30	3.00	12.85	1.10	2.70	1.40	.....	.....	.10
6	2.00	2.70	4.00	3.00	16.65	1.10	2.20	1.00	.....	.....	.10
7	2.00	2.60	4.40	4.50	12.95	1.00	3.50	.80	.....	.....	.10
8	1.90	2.50	6.00	6.00	8.70	1.00	2.80	.80	.....	.....	.10
9	1.80	2.50	6.10	5.60	9.70	1.00	2.80	.80	.....	.....	.10
10	1.80	2.80	6.10	4.70	10.00	1.00	2.20	.70	.....	.....	.10
11	1.70	2.20	5.10	3.80	7.60	1.20	2.00	.60	.....	.....	.10
12	1.60	2.10	4.60	3.30	5.70	1.20	1.90	.60	.....	.....	.10
13	1.60	4.20	4.00	3.70	4.80	1.10	1.80	.70	.....	.....	.20
14	1.60	5.30	3.70	3.10	4.40	2.00	1.80	.70	.....	.....	.20
15	1.50	4.70	3.30	3.00	3.80	1.90	1.20	.50	.....	.....	.20
16	1.50	4.40	3.30	2.60	3.00	1.00	1.10	.50	.....	.....	.20
17	1.50	6.00	6.60	2.00	2.70	1.00	1.80	.60	.....	.....	.10
18	2.40	17.70	4.90	1.90	2.80	1.00	2.00	.60	.....	.....	.00
19	11.70	11.30	4.40	1.60	2.80	1.00	1.00	.60	.....	.....	.00
20	11.70	8.00	3.70	1.00	2.40	2.30	1.00	.50	.....	.....	.00
21	9.40	7.70	3.60	1.00	2.30	2.50	.70	.50	.....	0.80	.10
22	11.20	6.70	4.10	1.00	2.00	3.70	.70	.50	.....	1.00	.10
23	9.40	8.50	4.00	1.00	2.10	3.00	.70	.50	.....	1.00	.30
24	7.90	6.50	5.40	1.00	3.00	2.20	.60	.60	.....	.60	.20
25	6.50	6.10	11.90	1.00	3.40	2.10	.60	.70	.....	.60	.40
26	5.70	5.60	8.70	1.00	2.00	2.00	.50	.80	.....	.40	1.10
27	5.00	6.10	5.00	1.30	2.00	1.90	.40	.90	.....	.40	3.00
28	4.60	6.60	4.50	1.00	2.00	1.90	.40	.80	.....	.40	3.30
29	4.10	5.40	4.30	1.00	2.00	1.80	.50	1.00	.....	.40	3.00
30	.....	5.00	4.30	1.00	2.00	2.00	.50	1.00	.....	.40	2.00
31	.....	4.40	.....	1.00	.....	[b]2.50	.50	.....	.....	.....	2.00

[a] Gage heights October 1 to November 20 omitted, owing to probable error. [b] Estimated.

Rating table for Ouachita River near Malvern, Ark., from March 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	40	1.70	590	3.40	1,800	6.20	5,140
.10	60	1.80	640	3.50	1,900	6.40	5,430
.20	80	1.90	700	3.60	2,000	6.60	5,730
.30	105	2.00	760	3.70	2,100	6.80	6,050
.40	130	2.10	820	3.80	2,200	7.00	6,380
.50	155	2.20	880	3.90	2,300	7.50	7,230
.60	180	2.30	940	4.00	2,400	8.00	8,100
.70	210	2.40	1,000	4.20	2,600	8.50	9,050
.80	240	2.50	1,070	4.40	2,820	9.00	10,050
.90	270	2.60	1,140	4.60	3,050	9.50	11,090
1.00	300	2.70	1,220	4.80	3,290	10.00	12,160
1.10	335	2.80	1,300	5.00	3,530	10.50	13,270
1.20	370	2.90	1,380	5.20	3,770	11.00	14,440
1.30	410	3.00	1,460	5.40	4,020	11.50	15,650
1.40	450	3.10	1,540	5.60	4,300	12.00	16,900
1.50	495	3.20	1,620	5.80	4,580		
1.60	540	3.30	1,710	6.00	4,860		

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 0.0 foot and 13 feet. The table has been extended beyond these limits. Above gage height 12 feet the rating curve is a tangent, the difference being 250 per tenth.

Estimated monthly discharge of Ouachita River near Malvern, Ark., for 1903 and 1904.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1903.			
March 3–31	36,900	1,900	8,914
April	1,710	640	1,006
May	37,400	640	5,231
June	5,430	240	1,210
July	880	155	248
August	8,100	270	2,176
September	5,430	300	1,177
October	25,900	300	2,323
November	300	210	229
December 1–26	1,620	210	386
1904.			
February	16,150	495	3,780
March	31,150	820	4,694
April	16,650	1,710	3,637
May	4,860	300	1,300
June	28,520	270	4,571
July	2,100	300	630
August	1,900	130	617
September	820	155	248
November 21–30	300	130	185
December	1,710	40	267

MISCELLANEOUS MEASUREMENTS IN RED RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Red River drainage basin in 1904:

Miscellaneous measurements in Red River drainage basin in 1904.

[By Elmas R. Kerby and L. M. Holt.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per sec.*	*Sec. ft.*
May 6	Elk Creek	Hobart, Okla	17	41	1.15	48
June 9	do	do	48	428	2.14	918
June 9	Little Elk Creek	do	18	36	.80	29
July 13	Elk Creek	do	15	24	1.19	29
Aug. 29	do	do	6	3	.72	2.2
Apr. 6	East Elk Creek	Salem, Okla	5.4	4.2	1.00	4.2
Apr. 22	Cache Creek	Lawton, Okla	14	6	.42	2.5
June 4	do	do	48	113	1.90	214
June 10	do	do	114	1,457	3.08	4,492
May 20	do	do	14	9.8	1.40	13.7
Sept. 5	do	do	6.5	2.7	.44	1.2
May 16	Medicine Creek	Fort Sill, Okla	18	18	2.98	54
June 4	do	do	19	9.5	1.16	11
May 5	Washita River	Clinton, Okla	77	479	2.91	1,395
Apr. 8	do	Shelley, Okla	45	36	1.18	42
Apr. 7	Boggy Creek	Bessie, Okla	4	1.7	1.2	2
May 5	Calvary Creek	Cordell, Okla	1	1.0	1.0	1
May 5	Boggy Creek	Bessie, Okla	17	12	2.02	24

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131: Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
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DEPARTMENT OF THE INTERIOR
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CHARLES D. WALCOTT, DIRECTOR

REPORT

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., March 20, 1905.

SIR: I transmit herewith the manuscript of Part IX of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of district hydrographers T. U. Taylor and W. M. Reed, and by the International (Water) Boundary Commission. The assembling of the data and its preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, A. H. Horton, and H. T. Colvin.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART IX.

By T. U. Taylor and John C. Hoyt.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	20,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

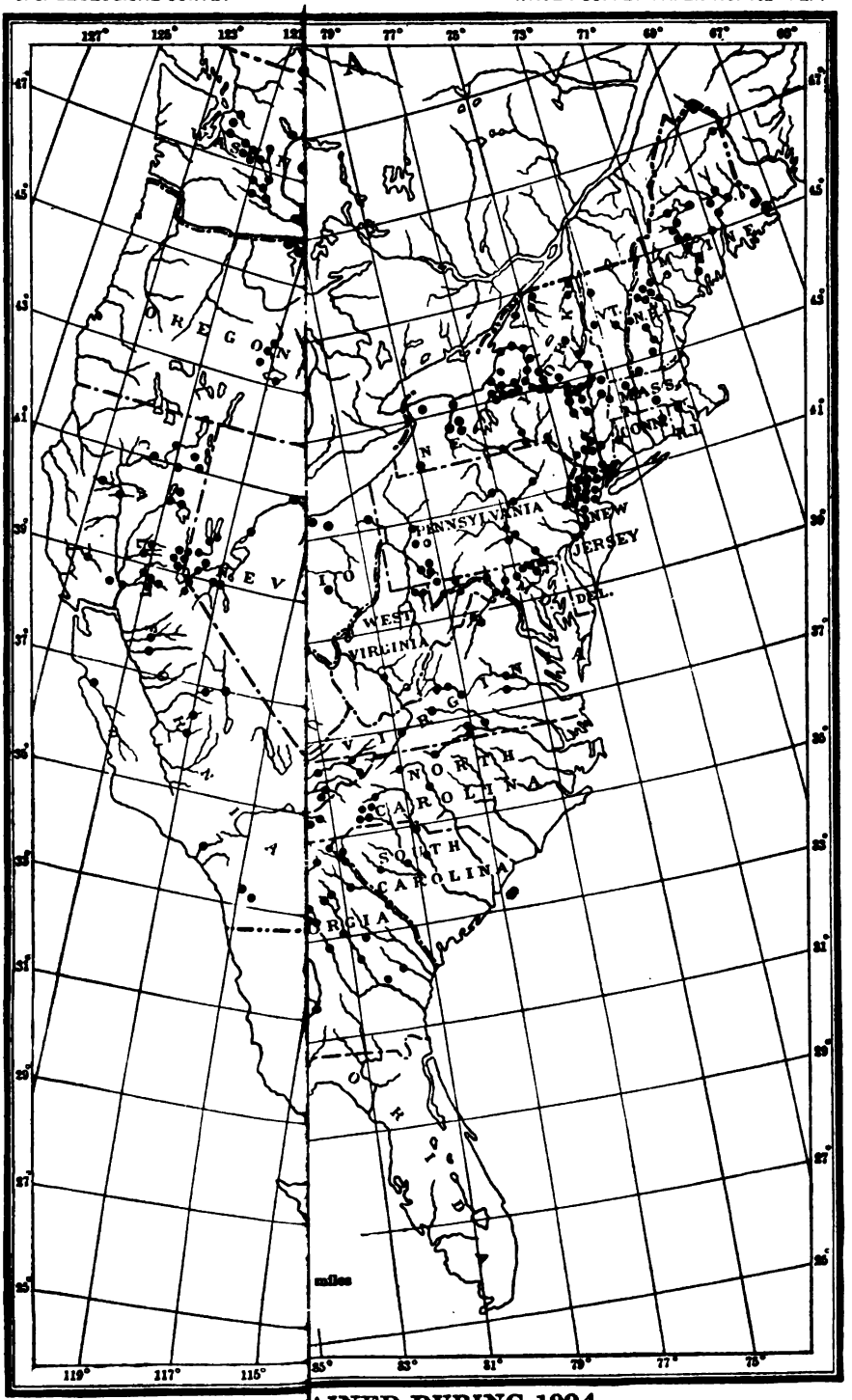
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage readings. From these two factors it is possible to estimate both the total flow and its distribution through the period of observations.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes, to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations; and second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station, with car, tag-line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge, or a tagged line indicating the points of measurement. Where the current is swift some appli-



MAINED DURING 1904.

ance—generally a secondary cable—is necessary to hold the meter in position below the surface.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located, as far as possible, at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. Great care is taken in the selection and equipment of gaging stations, in order that the data may have the required degree of accuracy.

On many of the larger rivers where water power is developed by dams, estimates of flow are obtained by observing the head on the crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

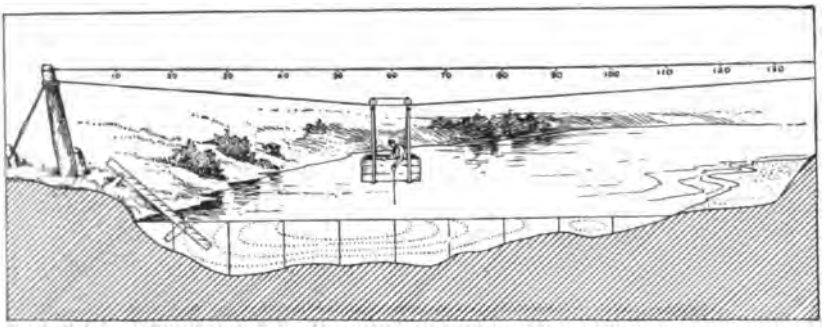


FIG. 1.—Cable station, showing section of river, car, gage, etc.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points are usually at regular intervals varying from 2 to 20 feet, depending

upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and soundings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth, for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between 0.94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical-velocity curves to be from .85 to .95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity-curve and the initial line. Owing to the length of time it takes to make these measurements, they

PRICE ELECTRIC CURRENT METERS, WITH BUZZERS.

are seldom used except for determining coefficients for purposes of comparison, and for measurements under ice.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity, twice the mid-depth velocity, and the bottom velocity, by 4.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area, on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of and increases gradually with the gage heights. (2 and 3 depend on 1.)

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds, the results of the discharge measurements are plotted on cross-section paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared.

The mean velocity and area determined for each discharge measurement are also plotted. Through these points the curves of mean velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value in determining the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station-rating curve, the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character, the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made, the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station-rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes occur.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are taken either by integration in verticals or by the vertical velocity-curve method, as sufficient experiments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part IX, is published in a series of twelve

Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainages.
Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.
Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.
Part 5. Eastern Mississippi River drainage.
Part 6. Great Lakes and St. Lawrence River drainage.
Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.
Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages
Part 9. Western Gulf of Mexico drainage.
Part 10. Colorado River and the Great Basin drainage.
Part 11. The Great Basin and Pacific Ocean drainage in California.
Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations and such other information that has been collected that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns which are defined on page 14 are based.

In the computations for the tables of this report, for stations maintained by the United States Geological Survey, the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications. A detailed index of these reports (from 1888–1903) is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to Members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Indian Territory.—District hydrographers, M. C. Hinderlider[a] and G. H. Matthes,[b] assisted by W. G. Russell. Acknowledgments are due to the Atchison, Topeka and

[a] Office, Chamber of Commerce Building, Denver, Colo.
[b] J. M. Giles has succeeded G. H. Matthes. Office, Carlsbad, N. Mex.

Santa Fe, the Missouri, Kansas and Texas, and the Chicago, Rock Island and Pacific Railway companies for annual passes issued to W. G. Russell.

New Mexico.—The work in northern New Mexico was carried on under the direction of M. C. Hinderlider, district hydrographer, assisted by W. G. Russell, G. B. Monk, and R. C. Prewitt. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River, acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of La Cueva, N. Mex.; also to J. D. Hand, of Los Alamos, N. Mex., for similar favors. Transportation in the form of an annual pass was furnished Mr. Monk by the Denver and Rio Grande Railroad, and to W. G. Russell by the Chicago, Rock Island and El Paso Railroad. For the purpose of collecting data in New Mexico during the latter part of the year an annual pass over the Atchison, Topeka and Santa Fe Railway was issued to G. B. Monk, for which acknowledgments are due.

The work in southern New Mexico was carried on by district hydrographer W. M. Reed,[a] assisted by F. S. Dobson.

Oklahoma.—District hydrographers, M. C. Hinderlider and G. H. Matthes, assisted by W. G. Russell. Acknowledgments are due to the Atchison, Topeka and Santa Fe, the Missouri, Kansas and Texas, and the Chicago, Rock Island and Pacific Railway companies for annual passes issued to W. G. Russell.

Texas.—District hydrographer, Thomas U. Taylor,[b] assisted by H. H. Fox, E. C. H. Bantel, and B. M. Haberer. Acknowledgments are due to the Missouri, Kansas and Texas, the International and Great Northern, the Houston and Texas Central, the Southern Pacific, the Texas Pacific, the Fort Worth and Denver, the Gulf, Colorado and Santa Fe, the St. Louis and Southwestern (Cotton Belt), and the San Antonio and Aransas Pass railroads for transportation for the district hydrographers. Also to the army engineers for gage heights at Riverside and for maps of Brazos River from Gulf to Waco.

Special acknowledgment is due to Gen. Anson Mills, commissioner, and W. W. Follett, consulting engineer of the International (Water) Boundary Commission, for the results of the data collected at certain stations in the Rio Grande drainage basin.

SABINE RIVER DRAINAGE BASIN.

Sabine River has its headwaters in Collin and Hunt counties, flows in a southeasterly direction to the State line, then south, forming the boundary between Texas and Louisiana, and empties into Sabine Lake, an arm of the Gulf, near Orange, Tex. The small tributaries in east Texas support many small water mills, and the Sabine itself is navigable for several hundred miles. The drainage area of the Sabine in Texas above Orange is 7,500 square miles, and its total drainage area above Orange in Louisiana and Texas is 10,400 square miles.

SABINE RIVER NEAR LONGVIEW, TEX.

This station was established January 1, 1904, by Thomas U. Taylor. It is located at the bridge of the International and Great Northern Railway, about 3 miles southwest of Longview Junction, Tex. A standard chain gage is attached to the guard rail of the bridge. The gage is read twice each day by John Wadsack. Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the east face of the west abutment.

[a] J. M. Giles has succeeded W. M. Reed. Office, Carlsbad, N. Mex.
[b] Office, Austin, Tex.

The channel is straight for 150 feet above and 400 feet below the station. The current is sluggish. The right bank is low and cleared along the right of way of the railroad. The left bank is high, and composed in its lower half of sandstone. It is cleared above and wooded below the station. The bed of the stream is rocky and fairly permanent. Old piles left from the false work used in erecting the bridge give trouble in making measurements at low water. Bench mark No. 1 is the top of abutment northeast corner, marked "U. S. G. S. 42.08 B. M." Its elevation is 42.08 feet above the gage datum. Bench mark No. 2 is the top of an iron rod buried in a vertical position in the yard of the bridge watchman, 6 feet from the southeast corner of his house, 3 feet east of the second post from the gate, and 8 inches from the wire fence. Its elevation is 47.00 feet above gage datum. Bench mark No. 3 is the top of tie at the gage. Its elevation is 45.00 feet above gage datum.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Sabine River near Longview, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 2	E. C. H. Bantel	.....	.....	9.10	512
June 8	H. H. Fox	543	1.51	10.30	820
June 9	.....do	763	1.83	12.25	1,390
June 10	.....do	1,006	1.90	14.23	1,920
June 11	.....do	1,334	1.90	16.95	2,530
June 11	.....do	1,505	1.84	18.30	2,780
June 12	.....do	1,593	1.89	19.00	3,010
June 13	.....do	1,738	1.92	19.90	3,330
June 15	.....do	1,895	1.95	21.00	3,703
June 17	.....do	1,969	1.97	21.55	3,872
June 18	.....do	1,810	1.84	20.40	3,340
June 19	.....do	1,652	1.74	19.30	2,875
June 20	.....do	1,483	1.63	18.10	2,420
June 20	.....do	1,410	1.63	17.50	2,300
June 21	.....do	1,140	1.52	15.30	1,730
June 21	.....do	963	1.47	13.86	1,420
June 21	.....do	822	1.47	12.72	1,204
June 22	.....do	565	1.38	10.50	780
June 22	.....do	453	1.24	9.42	560
June 23	.....do	396	1.22	8.78	485
June 24	.....do	355	1.10	8.30	392
June 24	.....do	375	1.14	8.60	426
Aug. 31	T. U. Taylor	186	.23	6.00	44

Mean daily gage height, in feet, of Sabine River near Longview, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.5	9.7	9.4	17.7	11.8	7.4	11.8	6.7	6.0	6.2	6.2	6.4
2	8.4	9.1	9.2	16.9	12.8	7.3	13.5	6.7	6.0	6.2	6.1	6.4
3	8.3	8.6	8.9	14.0	12.8	7.2	13.7	6.6	6.1	6.1	6.1	6.4
4	8.1	8.0	8.6	12.5	12.1	7.4	13.1	6.5	6.1	6.1	6.1	6.5
5	8.5	7.9	8.6	11.0	10.9	7.7	12.4	6.6	6.6	6.1	6.1	6.5
6	8.0	7.8	8.1	11.4	10.7	8.8	12.5	6.7	7.2	6.0	6.2	6.5
7	7.9	7.8	8.1	15.0	12.1	10.1	11.9	6.9	7.8	6.0	6.2	6.5
8	7.8	8.1	8.0	18.9	15.9	10.8	10.8	7.0	8.4	6.0	6.2	6.5
9	7.8	8.2	7.9	21.0	17.0	12.1	9.9	7.1	8.5	6.0	6.2	6.5
10	7.7	8.0	7.8	21.1	18.0	14.8	9.6	7.2	8.6	6.0	6.2	6.5
11	7.6	8.0	7.8	21.5	18.4	17.7	9.6	8.2	8.1	6.0	6.2	6.6
12	7.7	7.9	7.7	22.2	18.8	19.5	9.3	9.2	7.6	6.0	6.2	6.5
13	7.5	8.2	7.6	23.0	19.2	20.0	8.7	9.4	7.2	6.0	6.2	6.5
14	7.2	7.7	7.6	24.0	19.6	20.6	7.9	9.0	6.9	6.0	6.2	6.5
15	7.2	8.2	7.6	24.9	20.1	21.1	7.5	8.2	6.7	6.0	6.2	6.5
16	7.4	8.8	7.6	25.6	20.9	21.6	7.2	7.5	6.6	6.0	6.2	6.5
17	7.4	8.6	7.6	26.2	21.3	21.8	7.0	7.1	6.5	6.0	6.2	6.5
18	7.4	8.3	7.6	26.8	21.5	21.6	6.9	6.5	6.4	6.0	6.2	6.5
19	7.4	9.2	7.6	27.3	22.1	21.0	6.7	6.7	6.3	6.0	6.3	6.5
20	7.2	10.6	7.7	27.4	17.8	18.9	6.7	6.5	6.3	6.0	6.6	6.5
21	7.3	12.9	9.5	27.3	13.2	14.3	6.7	6.5	6.2	6.0	6.6	6.5
22	7.6	14.3	11.5	26.5	9.4	10.3	6.6	6.4	6.2	5.9	6.6	6.5
23	8.8	13.8	12.5	24.1	8.5	9.1	7.0	6.3	6.4	5.9	6.5	6.5
24	9.4	12.7	12.4	20.5	7.9	8.7	7.7	6.3	6.6	5.9	6.5	6.6
25	10.1	11.6	12.6	16.5	7.7	8.6	9.2	6.2	6.6	6.0	6.6	6.0
26	10.6	10.8	13.8	12.7	7.6	8.7	9.1	6.2	6.5	6.1	6.6	8.2
27	11.6	10.3	14.5	10.4	7.6	8.7	9.0	6.2	6.5	6.0	6.5	10.4
28	12.6	9.6	15.7	9.6	7.5	8.9	8.2	6.1	6.4	6.0	6.5	10.8
29	13.0	9.6	16.5	9.8	7.4	10.0	7.1	6.1	6.4	6.0	6.5	10.0
30	12.5	.....	17.2	10.8	7.6	10.6	7.0	6.1	6.3	6.0	6.4	9.7
31	10.6	.....	17.3	.....	7.6	.....	6.9	6.0	.....	6.2	.....	8.8

Rating table for Sabine River near Longview, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.90	35	7.90	300	10.60	826	15.50	1,975
6.00	44	8.00	317	10.80	869	16.00	2,103
6.10	53	8.10	335	11.00	913	16.50	2,233
6.20	63	8.20	353	11.20	957	17.00	2,366
6.30	74	8.30	371	11.40	1,001	17.50	2,501
6.40	85	8.40	389	11.60	1,045	18.00	2,640
6.50	97	8.50	407	11.80	1,090	18.50	2,785
6.60	109	8.60	426	12.00	1,136	19.00	2,938
6.70	122	8.70	445	12.20	1,182	19.50	3,100
6.80	135	8.80	464	12.40	1,228	20.00	3,269
6.90	148	8.90	483	12.60	1,274	20.50	3,446
7.00	162	9.00	502	12.80	1,320	21.00	3,630
7.10	176	9.10	521	13.00	1,366	21.50	3,824
7.20	190	9.20	540	13.20	1,413	22.00	4,030
7.30	205	9.40	580	13.40	1,461	22.50	4,244
7.40	220	9.60	620	13.60	1,509	23.00	4,464
7.50	235	9.80	660	13.80	1,557	24.00	4,919
7.60	251	10.00	700	14.00	1,605	25.00	5,386
7.70	267	10.20	742	14.50	1,725	26.00	5,863
7.80	283	10.40	784	15.00	1,850	27.00	6,348

The above table is based upon 23 discharge measurements made during 1904. It is well defined between gage heights 6 feet and 22 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Sabine River near Longview, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,366	190	464	28,530
February	1,677	267	613	35,260
March	2,447	251	787	48,390
April	6,544	620	3,425	203,800
May	4,072	220	1,683	103,500
June	3,946	190	1,571	93,480
July	1,533	109	556	34,190
August	580	44	166	10,210
September	426	44	145	8,628
October	63	36	46.2	2,841
November	109	53	76.1	4,528
December	869	44	199	12,240
The year	6,544	36	811	585,600

NECHES RIVER AT EVADALE, TEX.

A gaging station was established on Neches River at Evadale, July 1, 1904, by Thomas U. Taylor. It is located at the bridge of the Gulf, Beaumont and Kansas City Railroad. Gage readings are made by reading down from the top of the tie to the water surface by means of a tape. The zero of the gage is 40.00 feet below the top of tie in the west arm of the draw span of the bridge. The observer is W. H. Whittemore. The clear span or waterway under each arm of the draw span is 50 feet, and the bridge continues each way on trestles. The left bank is high, whence the name of the railroad station, Fords Bluff, but the right or west bank is low and the trestle work continues about half a mile from the river channel. At low water the current is very sluggish, and discharge measurements are made at shoals above or below the station.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Neches River at Evadale, Tex., in 1902 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1902.		*Feet.*	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second feet.*
September 10[a]	T. U. Taylor	22	15.6	1.67	.....	26
1904.						
July 16	T. U. Taylor	.....	1,800	.63	10.00	1,140
August 6	do	.....	1,590	.47	8.30	740
August 15[a]	do	18	18	1.61	.....	29
October 23	E. C. H. Bantel	100	1,360	.203	5.70	278

[a] Two hundred yards below railway bridge, near Price, on the International and Great Northern Railroad.

Mean daily gage height, in feet, of Neches River at Evadale, Tex., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.3	8.3	6.5	7.1	5.2	5.8
2	10.3	8.0	6.4	6.9	5.2	5.9
3	10.2	8.1	6.3	6.7	5.2	5.9
4	10.2	8.1	6.2	6.5	5.2	5.9
5	10.1	8.1	6.2	6.4	5.2	5.9
6	10.1	8.3	6.6	6.2	5.2	5.9
7	10.1	7.9	7.8	6.1	5.2	5.9
8	10.0	8.6	7.7	6.1	5.2	5.9
9	10.0	9.7	7.5	6.0	5.2	6.0
10	9.8	10.0	7.2	5.9	5.2	6.0
11	9.6	10.2	7.2	5.9	5.2	5.9
12	9.3	11.3	7.1	5.9	5.2	5.9
13	9.5	11.9	6.9	5.9	5.2	5.9
14	9.6	11.7	6.7	5.9	5.2	5.9
15	9.7	11.6	6.6	5.9	5.2	6.0
16	9.8	11.2	6.6	5.9	5.2	6.1
17	9.7	12.3	6.7	5.9	5.2	6.1
18	9.6	9.3	6.8	5.7	5.2	6.1
19	9.4	8.6	6.1	5.6	5.2	6.1
20	9.2	8.1	6.1	5.6	5.2	6.1
21	9.0	7.7	6.1	5.6	5.2	6.1
22	8.6	7.5	6.9	5.5	5.2	6.1
23	8.1	7.4	6.7	5.4	5.3	6.1
24	7.9	7.2	6.7	5.4	5.3	6.1
25	7.1	7.1	6.8	5.3	5.3	6.1
26	9.7	7.1	7.3	5.3	5.3	10.0
27	10.0	7.3	7.5	5.3	5.4	11.4
28	9.9	6.7	7.8	5.3	5.5	14.1
29	9.6	6.7	7.7	5.3	5.6	16.8
30	9.1	6.7	7.4	5.3	5.7	17.7
31	8.7	6.6	.....	5.2	.....	18.6

TRINITY RIVER DRAINAGE BASIN.

Trinity River rises in a network of small streams in the counties of Montague, Wise, and Parker, but their combined capacity at Dallas is not sufficient to keep the bottom or bed of the stream moist. The United States Geological Survey maintained a station at Dallas for a time, but it was abandoned on account of the small discharge. Below Dallas the Trinity flows through a wooded country, and consequently it is not subject to the sudden floods with their quick run-offs.

TRINITY RIVER AT RIVERSIDE, TEX.

A gaging station was established on Trinity River at Riverside, Tex., in December, 1902, by Thomas U. Taylor. The zero of the gage is 66.00 feet below the top of the ties (or base of rail) in the north arm of the draw span of the International and Great Northern Railroad bridge. The elevation of the top of the pivot pier above gage datum is 56.50 feet, and that of the top of the channel of the lower chord of the arms of the draw span of the bridge is 62.90 feet. According to the survey of the United States Army engineers the elevation of the top of the tie with reference to mean low tide of Gulf is 148.70 feet. The gage consists of a tagged plumber's chain, to which is attached a lead weight in the form of a frustum of a cone. The bottom of the lead weight is marked 66, and every foot above this is marked with a brass tag, giving its distance in feet above the bottom of the weight. The observer at Riverside is G. W. Higdon, who is in charge of the pumping plant of the International and Great Northern Railroad. In reading the gage it is only necessary to let the lead weight touch the water, and then read off the distance the mark or point is from the upper end or zero mark of the chain.

Measurements are made from the railroad bridge. The initial point for soundings is the north face of the south abutment for the south channel. For the north channel the north face of the pivot pier is the initial point. The channel is straight for 300 feet above and 1,000 feet below the bridge, and the current is sluggish at low stages and swift at high stages. The right bank is high and rocky. The left bank is lower than the right, a trestle being used to measure the overflow at flood stages. The bed of the stream consists of a tough mud or clay.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Trinity River at Riverside, Tex., in 1902 and 1903.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
September 10	T. U. Taylor	6.00	160
1903.			
March 18	T. U. Taylor	43.30	24,650
July 1	do	13.30	3,730
July 2	do	14.60	4,500
July 2	do	15.20	5,160
July 3	do	18.30	7,200
July 12	do	22.20	8,800
July 13	do	22.80	9,200
July 15	do	23.60	10,800
July 17	do	10.20	980
December 7	G. W. Higdon	8.30	420
December 12	do	9.30	500

Mean daily gage height, in feet, of Trinity River at Riverside, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.4	10.2	11.9	17.7	16.0	11.1	11.0	9.3	7.4	8.2	8.4	7.8
2	9.4	9.9	10.9	18.1	16.1	10.6	10.9	9.2	7.3	8.9	8.4	7.7
3	9.2	9.6	10.2	19.5	14.7	11.5	10.6	8.9	7.2	8.7	9.5	7.6
4	9.2	9.4	9.9	20.8	23.7	12.3	10.6	8.7	7.1	8.3	10.8	7.6
5	9.2	9.3	9.6	22.8	23.2	12.0	12.2	8.5	7.2	8.1	10.2	7.6
6	9.0	9.2	9.4	22.5	25.0	11.5	13.0	8.2	7.4	7.8	9.5	7.6
7	8.9	9.2	9.3	21.0	32.2	11.2	13.2	8.1	7.4	7.8	8.9	7.6
8	8.9	10.0	9.2	19.0	32.9	12.3	13.5	8.5	8.6	7.8	8.6	7.6
9	8.9	10.2	9.1	17.0	33.2	14.8	13.5	10.1	12.5	7.8	8.6	7.5
10	9.0	10.5	9.1	15.2	31.9	16.5	13.2	11.5	13.9	7.7	8.5	7.5
11	9.0	10.2	9.0	14.7	29.9	18.2	12.7	10.9	14.6	7.5	8.4	7.5
12	9.0	10.1	8.9	15.5	27.7	19.2	12.0	10.9	14.0	7.4	8.2	7.5
13	9.0	10.2	8.9	16.1	26.5	19.8	11.0	10.9	13.0	7.3	8.1	7.5
14	8.9	10.6	8.8	16.4	26.0	20.5	10.2	11.1	11.2	7.2	7.9	7.4
15	8.8	10.7	8.7	17.0	26.0	20.9	9.6	11.0	10.2	7.2	7.8	7.4
16	8.8	10.5	8.7	18.5	26.5	21.5	9.2	10.0	9.2	7.2	7.7	7.4
17	8.7	10.2	8.6	18.4	26.9	22.2	9.1	10.0	8.2	7.1	7.6	7.4
18	8.6	10.0	8.7	18.5	27.4	22.5	8.8	9.6	9.2	7.1	7.5	7.4
19	8.6	12.1	8.6	18.5	27.8	22.8	8.5	9.3	8.9	7.1	7.5	7.4
20	8.6	17.8	8.7	18.5	27.9	23.1	8.5	9.3	8.9	7.1	7.5	7.4
21	8.5	20.1	9.1	18.8	27.8	23.1	8.5	9.5	8.7	7.1	7.5	7.4
22	8.6	20.5	9.1	19.1	26.8	23.0	8.5	9.4	8.5	7.1	7.5	7.4
23	8.6	20.3	9.6	19.9	13.5	22.6	9.4	9.2	8.4	7.0	7.5	7.5
24	8.8	19.3	9.1	20.6	17.5	21.4	9.2	8.7	9.4	7.0	7.5	7.7
25	8.9	17.5	9.5	20.1	13.7	19.4	9.2	8.4	9.9	7.0	7.5	8.0
26	9.0	16.4	10.5	18.1	12.1	16.7	8.7	8.2	9.5	7.0	7.5	11.6
27	8.9	15.7	13.5	17.1	11.7	14.2	8.5	8.1	9.5	7.0	7.5	19.3
28	9.0	14.3	15.5	17.1	13.6	12.5	9.5	8.0	9.5	7.0	7.5	19.5
29	10.0	13.0	16.7	16.9	14.2	11.5	8.8	7.8	9.5	7.0	7.5	20.1
30	10.7	.....	17.4	16.2	12.2	11.2	9.3	7.7	9.4	7.0	7.5	17.5
31	10.6	.....	17.6	.....	11.7	.....	9.5	7.6	.....	7.0	.....	13.4

Rating table for Trinity River at Riverside, Tex., from January 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.00	160	9.10	780	12.20	2,910	18.50	7,320
7.10	170	9.20	840	12.40	3,050	19.00	7,670
7.20	180	9.30	900	12.60	3,190	19.50	8,020
7.30	195	9.40	965	12.80	3,330	20.00	8,370
7.40	210	9.50	1,030	13.00	3,470	20.50	8,720
7.50	225	9.60	1,095	13.20	3,610	21.00	9,070
7.60	245	9.70	1,160	13.40	3,750	22.00	9,770
7.70	265	9.80	1,230	13.60	3,890	23.00	10,470
7.80	285	9.90	1,300	13.80	4,030	24.00	11,170
7.90	310	10.00	1,370	14.00	4,170	25.00	11,870
8.00	335	10.10	1,440	14.20	4,310	26.00	12,570
8.10	360	10.20	1,510	14.40	4,450	27.00	13,270
8.20	390	10.40	1,650	14.60	4,590	28.00	13,970
8.30	420	10.60	1,790	14.80	4,730	30.00	15,370
8.40	455	10.80	1,930	15.00	4,870	32.00	16,770
8.50	490	11.00	2,070	15.50	5,220	34.00	18,170
8.60	530	11.20	2,210	16.00	5,570	36.00	19,570
8.70	575	11.40	2,350	16.50	5,920	38.00	20,970
8.80	620	11.60	2,490	17.00	6,270	40.00	22,370
8.90	670	11.80	2,630	17.50	6,620	44.00	25,170
9.00	725	12.00	2,770	18.00	6,970	47.00	27,270

The above table is based upon discharge measurements made during 1903. It is not well defined.

Estimated monthly discharge of Trinity River at Riverside, Tex., for 1904.

[Drainage area, 16,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,860	490	779	47,900	0.049	0.056
February	8,720	840	3,232	185,900	.202	.218
March	6,690	530	1,724	106,000	.108	.124
April	10,330	4,660	7,185	427,500	.449	.501
May	17,610	2,560	10,090	620,400	.631	.728
June	10,540	1,790	6,272	373,200	.392	.437
July	3,820	490	1,648	101,300	.103	.119
August	2,420	245	973	59,830	.061	.070
September	4,590	170	1,244	74,030	.078	.087
October	670	160	240	14,760	.015	.017
November	1,930	225	462	27,490	.029	.032
December	8,440	210	1,389	85,410	.087	.100
The year	17,610	160	2,936	2,124,000	.184	2.49

BRAZOS RIVER DRAINAGE BASIN.

This river has its source in the Staked Plains region of western Texas and has a general southeasterly course, emptying into the Gulf of Mexico south of the mouth of Trinity River. Its drainage basin is entirely within the State of Texas.

Under the direction of Thomas U. Taylor the United States Geological Survey is maintaining stations in this basin at Waco and Richmond, Tex.

BRAZOS RIVER AT WACO, TEX.

On September 14, 1898, a gage was established on the southwest bank of Brazos River at Waco. It consists of an inclined iron bar, 3 inches by 1 inch, reading from 0 to 4.3 feet, bolted to a hard-pine stick, 16 feet long, embedded in cement in the sloping limestone of the bank, flush with the surface, on which are painted the graduations above 4.3 feet.

This part of the gage is inclined to the horizontal at a slope of 27 horizontal to 5 vertical. In the summer of 1903 another section was added, with its lower end connected to the upper end of the first gage. It is similar to the first gage in construction, but is inclined at a slope of 9 horizontal to 4 vertical. It reads from 4.4 to 12 feet.

Three bench marks have been established. The first is on the lowest water table on the southwest pier of the suspension bridge and is

marked "U. S. G. S. 44.33 B. M." It is about on the level of the floor of the suspension bridge.

The hydrant at the corner of First and Austin streets is at an elevation (by gage) of 43.32 feet, while the top of the rail of the San Antonio and Aransas Pass Railroad a few feet from the hydrant is at an elevation of 41.12 feet. The bed of the river is shifting sand, and nearly every freshet modifies the cross section, so that at the same gage heights the river sometimes flows in one and sometimes in two channels under the suspension bridge from which the measurements are made.

At high water the gage reading is obtained by measuring to the water surface from the top rail of the stiffening truss of the suspension bridge at a certain point when there is no load upon the bridge and by taking this distance from 47.80 feet.

In the early part of 1902 a new camel-back truss bridge of one span was erected across the Brazos at Waco a few hundred feet above the suspension bridge. This new bridge crosses the river at an angle of 76°. It has a footway on the east or downstream side that affords excellent facilities for measuring the flow of the stream, and there are no midstream piers to render measurements troublesome or doubtful.

At the north end these bridges are 280 feet apart, and at the south end they are 380 feet apart. When the river is rising and drift prevents the use of the meter, good float measurements can be made by timing the drift as it passes from the upper to the lower bridge at the different panel points.

On the north pier of the new bridge a gage has been marked off by the city engineer to agree with the United States Geological Survey gage at the suspension bridge. The top of the cement floor of the new bridge at the southeast batter brace is at an elevation of 45.40 feet with respect to the United States Geological Survey gage. High-water gage heights can be read directly from the gage on the north pier, or the distance of the water surface can be measured from the cement floor, and this subtracted from 45.40 feet will give the height of the river referred to the gage.

The channel is straight for several hundred feet above and below the station and has a width at low stages of about 175 feet without piers. The bed is composed of firm sand, subject to some change. The current is rapid.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Brazos River at Waco, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 5	T. U. Taylor	189	1.00	2.50	188
February 12	do			2.85	240
March 8	do	113	0.64	2.10	73
March 19	E. C. H. Bantel			2.05	80
May 7	L. C. Robertson			10.50	12,300
May 7	do			8.60	7,200
June 21	T. U. Taylor			3.90	1,013
July 7	do			5.70	3,190
July 7	H. H. Fox	1,216	2.43	5.50	2,960
July 8	do	1,140	2.25	5.28	2,564
July 8	do	1,026	2.14	5.00	2,198
July 9	do	912	1.99	4.74	1,812
July 9	do	874	1.86	4.60	1,626
July 10	do	798	1.81	4.38	1,456

Mean daily gage height, in feet, of Brazos River at Waco, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.30	2.20	2.35	3.40	2.80	3.50	8.90	3.90	2.80	5.05	4.25	2.8
2	2.30	2.20	2.30	3.30	3.46	3.40	7.40	3.65	2.80	4.60	4.05	2.8
3	2.30	2.20	2.20	3.20	5.00	3.30	7.05	3.55	2.70	4.10	3.95	2.8
4	2.30	2.20	2.20	3.10	8.20	3.35	6.95	3.50	2.75	3.90	3.80	2.8
5	2.30	2.55	2.20	3.10	6.50	10.10	6.75	3.55	4.50	3.65	3.80	2.8
6	2.30	3.35	2.20	3.20	11.90	8.30	6.45	4.05	4.55	3.55	3.65	2.8
7	2.30	3.95	2.20	3.65	9.40	7.55	5.75	3.95	3.80	3.40	3.50	2.8
8	2.30	3.70	2.10	4.05	6.55	6.50	5.50	9.95	4.55	3.25	3.45	2.8
9	2.30	3.50	2.10	3.55	5.50	6.70	5.65	6.90	4.95	3.20	3.35	2.7
10	2.30	3.40	2.10	3.56	5.00	7.45	4.25	6.70	4.45	3.05	3.30	2.7
11	2.30	3.25	2.10	3.50	4.60	6.90	4.90	6.35	4.20	3.00	3.20	2.7
12	2.30	3.80	2.10	3.20	4.10	8.00	3.95	6.75	4.35	3.95	3.15	2.7
13	2.30	2.70	2.10	3.10	3.90	6.70	3.75	6.15	5.20	2.90	3.10	2.7
14	2.30	2.70	2.10	3.00	3.75	6.10	3.55	5.85	5.70	2.85	3.10	2.7
15	2.20	2.60	2.10	2.95	3.75	5.30	3.40	5.50	5.80	2.80	3.00	2.7
16	2.20	2.55	2.10	2.75	3.85	5.05	3.35	5.05	5.15	2.75	3.00	2.7
17	2.20	2.50	2.10	2.80	3.75	5.60	3.25	4.60	4.95	2.75	3.00	2.6
18	2.20	2.45	2.10	3.05	3.60	5.00	3.20	4.15	4.50	3.35	3.00	2.8
19	2.20	2.40	2.05	2.85	4.10	4.70	3.15	3.95	3.85	4.60	2.90	2.6
20	2.20	2.50	2.10	2.80	4.80	4.05	2.95	3.75	3.65	4.80	2.90	2.8
21	2.20	2.60	2.15	2.70	4.25	4.00	2.90	3.70	3.55	4.40	2.90	2.8
22	2.20	2.55	2.20	3.20	4.10	3.80	2.85	3.70	3.60	4.30	2.90	2.8
23	2.20	2.50	2.20	4.00	3.95	3.95	2.95	3.60	3.60	4.25	2.90	2.6
24	2.20	2.50	2.20	4.55	3.70	3.65	3.25	3.40	3.40	4.25	2.90	2.7
25	2.20	2.45	3.20	3.60	3.65	3.50	3.20	3.25	3.40	4.55	2.90	2.6
26	2.20	2.40	5.25	3.15	3.45	4.10	3.15	3.10	2.95	9.75	2.85	2.7
27	2.20	2.40	4.15	3.05	3.35	3.85	2.95	3.10	2.90	10.30	2.80	2.7
28	2.20	2.40	4.95	3.00	3.50	3.65	2.70	3.30	2.90	8.90	2.80	2.6
29	2.20	2.40	4.50	3.00	5.90	8.25	2.60	3.10	2.80	6.70	2.80	2.5
30	2.20	.....	4.05	2.85	3.90	12.75	3.15	3.00	4.25	5.20	2.80	2.5
31	2.20	.....	3.80	.....	3.60	.....	4.45	2.90	.....	4.60	.....	2.5

Rating table for Brazos River at Waco, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	62	3.50	665	5.00	2,005	7.00	4,645
2.10	82	3.60	740	5.10	2,115	7.20	4,955
2.20	104	3.70	820	5.20	2,225	7.40	5,275
2.30	128	3.80	900	5.30	2,340	7.60	5,605
2.40	155	3.90	980	5.40	2,455	7.80	5,945
2.50	184	4.00	1,065	5.50	2,575	8.00	6,300
2.60	215	4.10	1,150	5.60	2,700	8.50	7,225
2.70	248	4.20	1,235	5.70	2,825	9.00	8,200
2.80	284	4.30	1,320	5.80	2,955	9.50	9,230
2.90	323	4.40	1,410	5.90	3,085	10.00	10,320
3.00	365	4.50	1,500	6.00	3,220	11.00	12,640
3.10	410	4.60	1,595	6.20	3,490	12.00	15,130
3.20	460	4.70	1,695	6.40	3,770		
3.30	520	4.80	1,795	6.60	4,055		
3.40	590	4.90	1,900	6.80	4,345		

The above table is based upon discharge measurements made during 1900 to 1904, and is well defined. There was, however, a very slight change in the bed during 1904.

Estimated monthly discharge of Brazos River at Waco, Tex., for 1904.

[Drainage area, 30,750 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	128	104	115	7,010	0.0037	0.0043
February	1,022	104	305	17,540	.0099	.011
March	2,282	72	376	23,120	.012	.014
April	1,548	248	528	31,420	.017	.019
May	14,880	284	2,245	138,000	.073	.084
June	17,180	520	3,341	198,800	.109	.122
July	8,000	215	1,697	104,400	.055	.063
August	10,200	323	1,757	108,000	.057	.066
September	2,955	248	1,128	67,120	.037	.041
October	11,010	266	1,922	118,200	.063	.073
November	1,278	284	508	30,230	.017	.019
December	284	184	238	14,630	.0077	.0089
The year	17,180	72	1,180	858,500	.038	.525

BRAZOS RIVER AT RICHMOND, TEX.

This station was established January 1, 1903, by Thomas U. Taylor. It is located at the bridge of the Southern Pacific Railway Company. During 1903 the elevations of the water surface were determined by measuring down from a reference point on the bridge by means of a plumber's chain. During 1904 gage heights have been taken by means of a standard chain gage attached to the bridge. The gage is read once each day by A. O. Blum. Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the east face of the pier under the west end of the middle span. The channel is straight for 200 feet above and 900 feet below the station; has a width of about 175 feet at low water, without piers, and about 500 feet at ordinary high water, broken by three piers. During very high floods the left bank overflows and the width of the stream is 900 feet. The bed of the stream is sandy except around the piers, where it is stony, and is slightly shifting. The current is obstructed somewhat by old piles. The zero of the gage is 50 feet below the top of the guard rail in the middle of the sixth panel of the midspan on the downstream side of the bridge. Bench mark No. 1 is a point marked "R. F.," on the southeast corner of the tie seat of west abutment. Its elevation is 49.28 feet above the datum of the gage. Bench mark No. 2 is the top of the north bolt in flange of hydrant at corner of Railroad and First streets, 6 inches below the top of the hydrant. Its elevation is 47.26 feet above the datum of the gage. Bench mark No. 3 is the top of the northeast corner of base stone of "Our Heroes" monument in the court-house square. Its elevation is 53.52 feet above gage datum. The lowest gage height yet recorded is 1.80 feet above gage datum, or 45 feet above mean low sea level.

Above and at Waco the river rises rapidly, and when it gets above the gage height of 30 feet overflows the bottom lands below the town. When the floods spread out over the bottom lands, as they do from Waco to Richmond, the river stays up longer in its lower stretches than it does in the upper sections, as the bottoms and the lowlands serve as storage reservoirs for the backwater and are drained slowly as the river recedes. Above Waco the surface water rushes off into the stream more rapidly, and the river rises more suddenly and falls almost as suddenly. For this reason it is possible for the maximum discharge at Waco to be greater than it is at Richmond.

At Hearne and below the river in 1899 was several miles in width. Its maximum height at Richmond occurred on July 7, 1899, when it stood 4 feet below the top of the guard rail, or at a gage height of 46 feet. The water was out over the bottoms above, and in Richmond it covered the tracks of the Southern Pacific Railway.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Brazos River at Richmond, Tex., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
February 4	H. H. Fox	1.50	820
March 1	do	2.76	1,750
June 15	T. U. Taylor	7.70	7,500
June 24	do	4.30	3,090
August 5	do	2.30	1,520
August 9	do	2.70	1,950

Mean daily gage height, in feet, of Brazos River at Richmond, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.60	1.50	2.80	3.00	3.20	4.20	3.60	2.60	1.80	2.60	6.40	1.70
2	2.60	1.50	2.90	3.90	3.30	5.20	3.60	2.60	1.80	2.60	5.50	1.80
3	2.40	1.50	2.70	5.40	3.50	5.10	11.70	2.60	1.60	1.90	5.50	1.90
4	2.00	1.50	2.60	5.10	3.60	4.60	10.40	2.50	1.60	1.60	5.70	2.00
5	1.80	1.50	2.50	5.00	6.70	4.40	8.50	2.40	1.50	1.60	4.70	1.80
6	1.70	1.50	2.40	5.00	15.30	4.10	8.10	3.10	1.80	1.60	4.60	1.70
7	1.80	1.50	2.30	5.20	18.80	3.80	7.50	3.10	1.80	2.40	4.50	1.60
8	1.80	1.50	2.10	4.90	21.60	5.60	7.70	3.10	1.70	2.70	4.40	1.50
9	1.80	1.50	2.00	4.70	23.80	9.30	8.00	2.70	1.70	2.40	4.20	2.10
10	1.80	1.50	1.90	4.50	25.50	10.30	6.20	3.00	3.10	2.20	4.10	1.80
11	1.80	1.50	1.80	4.10	25.50	9.60	5.70	3.10	3.80	2.10	4.00	1.60
12	1.80	2.00	1.70	4.00	23.00	9.00	5.10	8.70	3.20	1.90	3.90	1.50
13	1.90	2.40	1.60	3.70	19.40	8.40	4.70	7.40	3.20	1.70	3.80	1.60
14	1.90	2.60	1.60	3.60	14.30	8.60	4.20	6.50	4.10	1.60	3.80	1.60
15	1.90	2.50	1.60	3.40	11.80	7.30	4.00	6.10	4.40	1.50	3.60	1.70
16	1.80	2.40	1.60	3.00	11.00	6.90	3.70	6.10	4.10	1.50	3.40	1.60
17	1.80	2.30	1.60	2.90	10.40	6.60	3.90	5.60	3.50	1.50	3.30	1.50
18	1.80	2.30	1.60	2.80	9.20	6.30	3.80	5.10	3.20	1.50	3.20	1.50
19	1.80	9.60	1.60	2.70	9.80	5.90	3.10	4.60	4.40	1.50	3.10	1.50
20	1.80	4.60	1.60	2.60	9.10	5.20	3.00	3.00	4.20	1.50	3.00	1.70
21	1.80	6.10	1.50	2.60	8.50	5.10	2.70	3.80	4.10	1.50	2.90	1.50
22	1.70	4.80	1.50	2.50	8.00	5.00	2.60	3.50	3.50	1.50	2.80	1.50
23	1.80	3.40	1.50	2.50	6.90	4.70	2.60	3.30	3.20	1.50	2.00	1.60
24	1.80	3.80	1.50	2.70	6.50	4.40	2.70	2.90	3.10	1.50	1.90	1.60
25	1.70	3.50	1.50	2.70	7.00	4.10	2.60	2.70	3.30	1.60	1.80	1.60
26	1.80	3.30	1.50	2.50	5.70	4.10	2.90	2.50	3.70	3.60	1.70	1.60
27	1.80	3.00	1.50	2.50	4.40	4.10	3.10	2.40	3.30	3.60	1.70	2.20
28	1.80	3.00	1.50	2.70	4.30	4.00	4.30	2.30	3.10	3.10	1.70	6.20
29	1.60	2.80	1.50	3.00	3.90	3.90	4.00	2.00	2.50	8.30	1.70	3.00
30	1.60	.....	1.50	3.10	3.70	3.70	3.00	1.90	2.60	10.30	1.70	3.40
31	1.50	.....	1.50	.....	4.60	.....	2.80	1.80	.....	8.00	.....	2.00

Rating table for Brazos River at Richmond, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	820	3.40	2,180	6.20	5,380	13.00	17,590
1.60	870	3.50	2,270	6.40	5,660	13.50	18,790
1.70	920	3.60	2,370	6.60	5,940	14.00	19,990
1.80	980	3.70	2,470	6.80	6,220	15.00	22,390
1.90	1,040	3.80	2,570	7.00	6,500	16.00	24,790
2.00	1,100	3.90	2,670	7.20	6,780	17.00	27,190
2.10	1,160	4.00	2,770	7.40	7,060	18.00	29,590
2.20	1,220	4.10	2,870	7.60	7,350	19.00	31,990
2.30	1,290	4.20	2,980	7.80	7,650	20.00	34,390
2.40	1,360	4.30	3,090	8.00	7,950	21.00	36,790
2.50	1,430	4.40	3,200	8.50	8,700	22.00	39,190
2.60	1,500	4.60	3,420	9.00	9,480	23.00	41,590
2.70	1,580	4.80	3,640	9.50	10,280	24.00	43,990
2.80	1,660	5.00	3,880	10.00	11,120	26.00	48,790
2.90	1,740	5.20	4,120	10.50	12,020	28.00	53,590
3.00	1,820	5.40	4,360	11.00	13,020	30.00	58,390
3.10	1,910	5.60	4,600	11.50	14,120	33.00	65,590
3.20	2,000	5.80	4,860	12.00	15,270		
3.30	2,090	6.00	5,120	12.50	16,420		

The above table is based upon 27 discharge measurements made during 1902 to 1904, inclusive, and is well defined. Above gage height 13 feet the rating curve is a tangent, the difference being 240 per tenth. Above gage height 10 feet this table is the same as that for 1903.

Estimated monthly discharge of Brazos River at Richmond, Tex., for 1904.

[Drainage area, 44,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,500	820	1,017	62,530	0.023	0.026
February	10,440	820	1,914	110,100	.044	.047
March	1,740	820	1,024	62,960	.023	.026
April	4,360	1,430	2,399	142,800	.055	.061
May	47,590	2,000	15,040	924,800	.342	.394
June	11,660	2,470	5,056	300,900	.115	.128
July	14,580	1,500	4,052	249,100	.092	.106
August	9,000	980	2,645	162,600	.060	.069
September	3,200	820	1,891	112,500	.043	.048
October	11,660	820	1,932	118,800	.044	.051
November	5,660	920	2,424	144,200	.055	.061
December	5,380	820	1,135	69,790	.026	.030
The year	47,590	820	3,377	2,461,000	.077	1.05

COLORADO RIVER (OF TEXAS) DRAINAGE BASIN.

Colorado River rises in the extreme western portion of the State, within a few miles of the eastern boundary of New Mexico, and flows in a general southeasterly direction, emptying into the Gulf of Mexico in Matagorda County. The drainage area above Austin is 37,000 square miles and above Columbus 40,000 square miles, and it extends into the corner of New Mexico. Its main tributaries are the Concho, the San Saba, and the Llano. The Concho has a reliable flow above its junction with the Colorado, and if the stream below the junction were to receive its name from the one that contributed the most water the river below the junction would be known as the Concho instead of the Colorado. The Concho furnishes water for irrigation and water power, and supports in Irion and Tom Green counties some excellent irrigation systems, described in Water-Supply Paper No. 71. San Saba and Llano rivers are described in the same paper.

The Colorado at Austin emerges from a canyon. From Austin to the Gulf it traverses a rather flat country, and its waters are utilized for many power plants; 60,000 acres of rice were sowed during the season of 1902 in the counties of Colorado, Wharton, and Matagorda, under canals that obtained their water from the Colorado.

Under the direction of Thomas U. Taylor the United States Geological Survey is maintaining gaging stations in this basin at Columbus and Austin, Tex.

COLORADO RIVER AT AUSTIN, TEX.

The flood of April 7, 1900, carried away the great masonry dam at Austin. This flood was general over southwest Texas, but its only disaster was limited to the demolition of that structure. A full discussion of this failure will be found in Water-Supply Paper No. 40.

Prior to the flood of April 7, 1900, the discharge of the river at the station below the dam was at low stages absolutely under the control of the turbines at the power house at the dam; and measurements made opposite the city, at the station between the two bridges, did not give the unobstructed flow of the river.

Gage heights were first taken on the crest of the Austin dam on August 13, 1895, and were continued from that date until the failure of the dam occurred in April, 1900. The first discharge measurement was made on December 21, 1897. In February, 1899, the gage was placed on Congress Avenue Bridge, south of the city. This gage consisted of a plain staff attached to a bath house. During 1904 a standard chain gage was attached to the bridge at the same elevation as the old one. The gage is read twice each day by W. Peterson. A gage is also marked off on the first pier from the north. Discharge measurements are made by means of a cable and car 3 miles above Congress Avenue Bridge, to which the gage is attached, and about one-eighth mile above the ruins of the Austin dam and power house. The cable has a span of about 730 feet, but the width of the river at low water is less than half this distance. The channel is straight for 400 feet above and below the station. The velocity is moderately rapid. Neither bank has overflowed since the dam was washed away. The bed of the stream is composed of sand and is slightly shifting. Bench mark No. 1 is a United States Coast and Geodetic Survey copper bolt on the top of the west end of the south pier of Congress Avenue Bridge, 475 feet above mean sea level. Its elevation is 48.00 feet above the datum of the gage. Bench mark No. 2 is a similar bolt in the southwest wall of the post-office at Austin, 508 feet above mean sea level, about 4 feet above the walk. Its elevation is 81.00 feet above the datum of the gage. Bench mark No. 3 is on the first flange above the cribwork of the north pier of the bridge, marked "U. S. G. S. B. M. 4.78." Its elevation is 4.78 feet above gage datum and 431.78 feet above mean sea level.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Colorado River at Austin, Tex., in 1904.

Date.	Hydrographer	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 6	E. C. H. Bantel	.....	.....	1.22	358
May 5	do	2,554	4.08	5.50	10,520
May 5	do	2,322	3.94	5.30	9,150
May 5	do	2,394	3.79	5.20	9,073
May 5	do	2,327	3.80	5.20	8,853
May 6	do	3,107	4.26	6.00	13,230
May 6	do	2,796	4.20	5.70	11,640
May 6	do	2,660	4.05	5.60	10,780
May 6	do	2,608	3.85	5.30	10,060
May 7	do	2,075	3.60	4.90	7,492
May 7	do	2,116	3.47	4.90	7,350
May 7	do	2,008	3.51	4.80	7,180
May 7	do	2,019	3.58	4.80	7,239
May 10	T. U. Taylor	278	1.62	1.45	452
December 13	H. H. Fox	271	1.60	1.32	429
December 23	do	256	1.23	1.20	325

Mean daily gage height, in feet, of Colorado River at Austin, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.20	1.20	1.40	1.50	1.80	5.75	7.10	2.00	0.80	2.40	2.35	1.30
2	1.20	1.20	1.38	1.45	1.70	3.55	5.25	1.90	.70	2.30	2.00	1.30
3	1.20	1.20	1.30	1.30	5.00	3.10	4.75	1.60	.70	2.15	1.95	1.30
4	1.20	1.20	1.30	1.35	2.80	2.75	5.90	2.15	.70	1.95	1.75	1.30
5	1.20	1.20	1.20	1.55	5.80	2.60	3.80	2.05	5.95	1.75	1.70	1.30
6	1.20	1.20	1.25	1.45	6.00	6.50	3.80	1.75	4.60	1.70	1.70	1.40
7	1.20	2.00	1.20	1.30	5.30	9.35	2.85	1.90	3.05	1.55	1.65	1.40
8	1.20	2.45	1.20	1.20	5.05	10.35	2.50	4.95	3.00	1.50	1.60	1.50
9	1.20	2.65	1.20	1.20	4.80	8.05	2.25	3.05	2.85	1.50	1.50	1.50
10	1.20	2.35	1.20	1.10	3.35	6.20	2.15	2.70	2.25	1.40	1.50	1.50
11	1.20	2.10	1.15	1.10	3.80	5.40	2.10	2.25	2.00	1.40	1.40	1.40
12	1.20	1.85	1.15	1.05	2.45	4.25	1.80	1.85	2.00	1.30	1.40	1.30
13	1.20	1.70	1.15	1.00	2.20	3.15	1.75	1.75	4.45	1.20	1.40	1.30
14	1.20	1.55	1.15	1.00	2.00	3.55	1.70	1.60	2.80	1.20	1.40	1.30
15	1.20	1.50	1.00	1.00	1.90	2.95	1.70	1.95	4.45	1.10	1.40	1.30
16	1.20	1.40	1.10	.90	1.95	2.65	1.50	1.80	3.60	1.00	1.30	1.30
17	1.20	1.30	1.17	.90	1.95	2.50	1.40	1.75	3.00	1.00	1.30	1.30
18	1.20	1.30	1.10	.90	1.85	2.40	1.30	1.70	2.40	1.50	1.30	1.20
19	1.20	1.40	1.10	.90	1.70	2.35	1.20	1.55	2.40	1.50	1.30	1.20
20	1.20	1.50	1.10	.90	3.35	2.25	1.10	1.50	2.00	1.30	1.30	1.20
21	1.20	1.50	1.70	.90	2.65	2.20	1.10	1.55	1.90	1.20	1.30	1.20
22	1.20	1.50	1.75	1.60	2.35	2.05	1.10	1.65	1.80	1.10	1.30	1.20
23	1.20	1.50	1.95	1.75	2.45	2.70	1.10	1.40	1.70	2.30	1.30	1.30
24	1.20	1.80	1.70	3.70	2.30	2.70	1.55	1.25	1.70	2.10	1.30	1.20
25	1.20	1.85	1.55	3.90	2.05	3.10	1.30	1.05	3.55	2.10	1.30	1.25
26	1.20	1.65	1.45	2.70	2.00	3.05	1.60	1.00	4.05	2.45	1.30	1.25
27	1.20	1.52	1.27	2.10	2.00	2.55	1.40	1.00	3.10	5.25	1.30	1.30
28	1.20	1.50	1.22	1.65	1.90	2.30	1.25	1.00	2.90	4.10	1.20	1.20
29	1.20	1.40	1.35	1.80	1.80	2.15	1.55	.90	2.90	3.15	1.25	1.20
30	1.20	.....	1.55	1.70	3.55	3.90	1.90	.85	2.60	3.15	1.30	1.30
31	1.20	.....	1.55	.....	2.95	.....	1.90	.80	.....	2.75	.....	1.30

Rating table for Colorado River at Austin, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Fee'.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	200	2.00	760	3.30	2,650	5.20	8,850
.80	223	2.10	840	3.40	2,880	5.40	9,850
.90	248	2.20	930	3.50	3,120	5.60	10,920
1.00	275	2.30	1,030	3.60	3,365	5.80	12,050
1.10	305	2.40	1,140	3.70	3,615	6.00	13,220
1.20	339	2.50	1,260	3.80	3,870	6.50	16,320
1.30	377	2.60	1,390	3.90	4,130	7.00	19,670
1.40	419	2.70	1,530	4.00	4,395	8.00	27,000
1.50	465	2.80	1,680	4.20	4,955	9.00	34,900
1.60	515	2.90	1,840	4.40	5,595	10.00	43,170
1.70	568	3.00	2,020	4.60	6,315		
1.80	625	3.10	2,220	4.80	7,090		
1.90	688	3.20	2,430	5.00	7,930		

The above table is based upon 30 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.20 feet and 6 feet. The table has been extended beyond these limits. Between gage heights 2 feet and 4.7 feet the table is the same as that for 1903.

Estimated monthly discharge of Colorado River at Austin, Tex., for 1904.

[Drainage area, 37,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	339	339	339	20,840	0.0092	0.011
February	1,460	339	558	32,100	.015	.016
March	724	275	394	24,230	.011	.013
April	4,130	248	661	39,330	.018	.020
May	13,220	568	2,900	178,300	.078	.090
June	46,140	800	6,904	410,800	.187	.209
July	20,370	305	2,311	142,100	.062	.072
August	7,715	223	843	51,830	.023	.026
September	12,920	200	2,254	134,100	.061	.068
October	9,095	275	1,129	69,420	.031	.036
November	1,085	339	466	27,730	.013	.014
December	465	339	376	23,120	.010	.012
The year	46,140	200	1,595	1,154,000	.043	.587

COLORADO RIVER AT COLUMBUS, TEX.

This station was established in December, 1902, by Thomas U. Taylor. There is a gage marked on the downstream side of the pier on the west side of the river. Gage datum is taken as 50 feet below the top of this pier, and the observer, W. E. Bridge, measures down from this point with a tagged chain and lead weight. Discharge measurements are made from the 3-span highway bridge at which the gage is located. The channel is straight for 200 feet above and 600 feet below the stream and has a width of 140 feet at low water, unobstructed by piers, and a width of 450 feet at ordinary high water, broken by two piers. At very high stages the left bank overflows for several hundred feet, but the water passes under the iron trestle approach to the bridge. The bed is composed of gravel and sand and is fairly permanent. Bench mark No. 1 is the top of pier at west end of mid span of bridge. Its elevation is 50.00 feet above the zero of the gage. Bench mark No. 2 is the east end of top of the top stone step at south door of Columbus jail. Its elevation is 53.22 feet above gage datum. Bench mark No. 3 is the north end of top stone step at east door of Columbus court-house. Its elevation is 53.91 feet above the datum of the gage. Bench mark No. 4 is the top of rail over the extreme west pier of Southern Railway Bridge crossing the river above the gaging station. Its elevation is 51.13 feet above gage datum.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Colorado River at Columbus, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
February 5	H. H. Fox	306	1.48	5.50	454
February 5	do			5.50	450
March 1	E. C. Murphy	387	2.10	6.05	820
May 6	H. H. Fox			25.80	23,800
May 7	do			22.20	17,230
May 8	do			19.90	13,710
May 8	do			17.80	10,900
May 8	do			16.50	8,956
May 9	do			14.55	7,135
May 11	do			13.30	6,172
May 12	do			11.90	4,940
May 12	do			11.10	4,112
May 13	do	1,208	2.45	9.60	2,963

Mean daily gage height, in feet, of Colorado River at Columbus, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.00	6.00	6.10	5.55	7.40	7.50	8.70	6.40	6.00	9.15	11.10	6.60
2	6.00	6.00	6.00	5.55	7.65	10.20	10.05	6.50	6.00	9.05	9.80	6.60
3	6.00	6.00	5.80	8.20	8.00	13.45	16.85	7.05	5.90	8.85	9.05	6.60
4	6.00	5.50	5.70	7.90	20.15	11.85	14.55	7.35	5.90	8.15	8.40	6.05
5	6.00	5.50	5.70	7.70	28.50	10.45	13.35	7.35	5.80	7.95	8.05	6.05
6	6.00	5.50	5.60	7.60	26.15	9.85	12.05	6.90	6.15	7.70	7.75	5.90
7	6.60	5.50	5.60	6.10	23.00	9.20	10.50	6.85	8.90	7.55	7.60	5.90
8	6.00	5.50	5.45	5.95	19.00	21.40	10.60	14.65	12.75	7.20	7.45	5.90
9	6.00	5.50	5.45	5.80	14.95	24.60	8.90	13.00	11.55	7.10	7.20	5.90
10	6.00	5.50	5.50	5.70	14.30	25.50	8.55	11.95	10.35	6.80	6.95	6.00
11	6.00	5.95	5.50	5.70	14.60	20.35	8.20	12.20	10.20	6.70	6.90	6.00
12	5.80	7.35	5.50	5.70	11.75	17.00	8.00	10.35	9.05	6.55	6.75	6.30
13	5.80	7.40	5.35	5.60	10.10	14.95	7.70	9.25	8.40	6.50	6.60	6.20
14	5.50	7.00	5.50	5.60	9.25	12.90	7.45	8.35	8.10	6.40	6.60	6.10
15	5.50	6.40	5.40	5.55	8.75	11.40	7.35	7.95	9.50	6.30	6.50	6.00
16	5.50	6.30	5.40	5.50	8.30	10.60	7.25	7.75	10.85	6.30	6.50	6.00
17	5.50	6.20	5.50	5.40	10.10	10.10	6.95	7.20	10.50	6.15	6.50	6.00
18	5.50	6.75	5.50	5.40	9.75	9.60	6.90	7.16	11.45	6.10	6.40	6.00
19	5.50	6.45	5.40	5.40	9.40	9.40	6.90	7.50	10.25	6.10	6.40	6.00
20	5.50	6.25	5.40	5.40	8.65	8.45	6.70	7.30	9.25	6.05	6.40	6.00
21	5.50	6.25	5.40	5.40	7.70	8.40	7.50	7.25	8.50	6.00	6.50	6.00
22	5.50	6.00	5.40	5.40	7.50	8.35	6.95	7.20	11.00	6.00	6.60	6.00
23	5.50	6.00	5.60	5.50	9.25	8.60	6.90	7.05	10.80	6.00	6.50	6.00
24	6.00	6.00	5.40	5.50	8.70	9.80	9.06	6.55	8.60	6.00	6.40	6.00
25	6.00	6.00	5.40	5.50	8.20	9.70	9.15	6.45	7.80	8.10	6.40	6.05
26	6.00	6.00	5.85	6.00	8.05	8.75	8.10	6.45	7.30	12.25	6.40	22.00
27	6.00	6.00	6.10	10.65	8.05	8.70	7.05	6.40	7.10	11.05	6.30	15.00
28	6.00	6.00	5.90	9.10	7.65	9.15	6.75	6.35	11.65	8.85	6.30	9.00
29	6.00	6.25	5.75	9.60	7.40	9.85	6.55	6.30	11.60	15.75	6.30	7.35
30	6.00	.....	5.50	7.75	7.30	8.85	6.50	6.00	10.00	14.30	6.30	6.95
31	6.00	.....	5.60	.....	7.65	.....	6.50	6.00	.....	12.25	.....	6.60

Rating table for Colorado River at Columbus, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.40	510	7.10	1,340	9.20	2,710	13.50	6,160
5.50	550	7.20	1,400	9.40	2,850	14.00	6,610
5.60	590	7.30	1,460	9.60	2,990	14.50	7,090
5.70	630	7.40	1,520	9.80	3,130	15.00	7,590
5.80	680	7.50	1,580	10.00	3,270	16.00	8,660
5.90	730	7.60	1,640	10.20	3,410	17.00	9,860
6.00	780	7.70	1,700	10.40	3,570	18.00	11,140
6.10	830	7.80	1,760	10.60	3,730	19.00	12,520
6.20	880	7.90	1,820	10.80	3,890	20.00	13,970
6.30	930	8.00	1,880	11.00	4,050	21.00	15,470
6.40	980	8.10	1,940	11.20	4,210	22.00	17,030
6.50	1,030	8.20	2,010	11.40	4,370	23.00	18,700
6.60	1,080	8.30	2,080	11.60	4,530	24.00	20,420
6.70	1,130	8.40	2,150	11.80	4,690	25.00	22,200
6.80	1,180	8.60	2,290	12.00	4,850	26.00	24,070
6.90	1,230	8.80	2,430	12.50	5,260	27.00	25,980
7.00	1,280	9.00	2,570	13.00	5,710	28.00	27,920

The above table is based upon 24 discharge measurements made during 1902 to 1904, inclusive. It is fairly well defined.

Estimated monthly discharge of Colorado River at Columbus, Tex., for 1904.

[Drainage area, 40,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	780	550	699	42,980	0.017	0.020
February	1,520	550	840	48,320	.021	.023
March	830	390	587	36,090	.015	.017
April	3,770	510	1,046	62,240	.026	.029
May	28,900	1,460	5,572	342,600	.139	.160
June	23,140	1,580	5,627	234,800	.141	.157
July	9,675	1,030	2,494	153,400	.062	.071
August	7,240	780	1,965	120,800	.049	.056
September	5,485	680	2,705	161,000	.068	.076
October	8,390	780	2,102	129,200	.053	.061
November	4,130	930	1,396	83,070	.035	.039
December	17,030	730	1,664	102,300	.042	.048
The year	28,900	390	2,225	1,517,000	.056	.757

LIPAN SPRING NEAR SAN ANGELO, TEX.

Lipan Spring is 18 miles from San Angelo in southeasterly direction. Its discharge in the latter part of December, 1904, was 1 second-foot. The water is used for irrigation purposes on a few small farms.

KICKAPOO SPRING NEAR SAN ANGELO, TEX.

Kickapoo Spring is located in Tom Green County, Tex., about 20 miles in a southeast direction from San Angelo. This spring forms the headwaters of Kickapoo Creek and the waters are used for stock and irrigation purposes. The creek flows in a northeast direction for 30 miles to its junction with Concho River, 2 miles above Paint Rock. The discharge was measured at the head spring December 20, 1904, by O. L. Sims and a flow of 4 second-feet was found.

SAN SABA RIVER AT SAN SABA, TEX.

San Saba River rises in two springs near Fort McKavett, in the western part of Menard County, Tex., and flows in an easterly direction for over 100 miles to its junction with Colorado (of Texas) River. It is fed by many springs between Fort McKavett and Menardville, the largest of which is the one that feeds or is the source of Clear Creek.

A gaging station was established on San Saba River at the suspension bridge 1 mile northwest of the town of San Saba, Tex., December 30, 1904, by E. C. H. Bantel. The elevations of the water surface are determined by measuring down by means of a tape from a certain casting on the upstream face in the flooring of the bridge, the zero elevation being 40.00 feet below the same. Discharge measurements are made from the single-span bridge at which the gage is located. The initial point for soundings is the north face of the south pier. The channel is straight for 150 feet above and 1,000 feet below the station. The current is swift at high and sluggish at low stages. Both banks are high and liable to overflow at high stages. The bed of the stream is composed of sand and gravel. There is but one channel at all stages. Bench mark No. 1 is a large wire nail driven into a tree 50 feet from the south end of the bridge. Its elevation is 37.63 feet above the zero of the gage. Bench mark No. 2 is a wire nail driven into a water elm 70 feet from the north end of the bridge, on the east side of the road. Its elevation is 37.16 feet above the zero of the gage. Bench mark No. 3 is a wire nail driven into a live oak tree 200 feet from the south end of the bridge and 50 feet from the edge of the south bank of the stream. Its elevation is 37.16 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of San Saba River at San Saba, Tex., in 1902 and 1904.

Date.	Hydrographer.	Discharge.
1902.		*Second-feet.*
August	T. U. Taylor	[a] 26
1904.		
December 20[b]	O. L. Sims	[a] 15

[a] One mile below Fort McKavett.
[b] The measurement of December 20, 1904, can be regarded as the probable minimum flow, as all the streams in the northern part of the Edwards Plateau were at very low stages at this period of the year 1904.

BARTONS SPRINGS NEAR AUSTIN, TEX.

These springs are located about 2 miles southwest of Austin, Tex., and are similar in behavior and in flow to the Comal, San Felipe, and San Marcos. They respond in increased flow to the rainfall in the Edwards Plateau, but this response is always delayed some months. About a quarter of a mile from the head spring, the Walsh Spring formerly was active and operated a small mill, but it went dry several years ago, but revived in the wet season of 1900 and continued flowing till the early part of 1901, when it again ceased flowing. It continued dry till the early part of 1903 when it again revived. On June 6, 1903, the flow of the Walsh Spring was 8.5 second-feet, but it stopped flowing in the latter part of 1903 and has since remained dry.

Discharge measurements of Bartons Springs, near Austin, Tex., 1894–1904.

Date.	Hydrographer.	Discharge.
		Second-feet.
1894	C. C. Babb	17
1895	do	25
March, 1898	T. U. Taylor	20
May, 1898	do	30
August, 1900	do	69
December 1900	do	33
June, 1902	do	19
August, 1902	do	19
June, 1903	A. A. Cother	69
June, 1904	T. U. Taylor	43

MORMON SPRINGS NEAR AUSTIN, TEX.

About 1 mile above the Austin dam on the left or east bank of the river are some springs known from some former campers as Mormon Springs. These springs were in the lake formed by the backwater from the Austin dam. At present they break out in several places, and the only way to get their total flow is to follow along the river edge and measure the discharge of each as it enters Colorado River. The flow of these springs as they existed in August, 1904, was measured by Thomas U. Taylor, and the full capacity of the three outlets was 3 second-feet.

GUADALUPE RIVER DRAINAGE BASIN.

Guadalupe River rises in the southern central part of Texas, flows southeast, and empties into San Antonio Bay. During the summer of 1902 its discharge was the least in its observed history, causing much loss above New Braunfels, where half a dozen power plants were forced to shut down or to run on short time. The flow at this time was so low that special efforts were made to obtain measurements at several points along its course.

Under the direction of Thomas U. Taylor the United States Geological Survey is maintaining a station in this basin near Cuero, Tex.

GUADALUPE RIVER NEAR CUERO, TEX.

The Guadalupe, while the best water-power stream in Texas, has a drainage area above Cuero of only 5,100 square miles. Its efficiency is due almost entirely to the canal at New Braunfels. Below New Braunfels the largest tributary is San Marcos River.

This station was established by Thomas U. Taylor December 26, 1902. The original location of the gage was at the dam at Carl Buchel's power house, 3 miles north of Cuero, Tex. This gage is a vertical staff mounted on the wall of the power house near the dam, and was read twice each day by Carl Buchel.

For the old station the initial point for soundings was on the left bank. The channel is straight for about one-fourth of a mile above and 400 feet below the station. The right bank is low and liable to overflow; the left bank is high and rocky. The bed of the stream is of clay. The bench mark is on the crest of the dam. Its elevation is the same as the zero of the gage.

As it proved impossible to measure flood discharges at this point, a new station was established in July, 1903, at the bridge of the San Antonio and Aransas Pass Railroad 3 miles west of Cuero. A standard chain gage is attached to the bridge. The gage is read twice each day by Robert Miller. Discharge measurements are made from the highway bridge, 200 feet below the railway bridge, when the gage is above

7 feet, but at lower stages the discharge is measured on the crest of the Buchel dam, 3 miles upstream. The crest of this dam is 110 feet long and 4 feet wide. The initial point for soundings at the bridge is the east face of the tubular pier under the west end of the highway bridge. The channel is straight and has a width of 125 feet at low stages. The right bank is low and overflows for several hundred feet at high stages. The section is deep and the flow is sluggish. The bed is composed of soft material and may change somewhat. Bench mark No. 1 is the top of the tie in the third panel from the east end of the bridge. Its elevation is 50.00 feet above the datum of the gage. Bench mark No. 2 is the seat of the valve, about 100 feet from the pump house, on the line of pipe that leads from the pump to the water tank. Its elevation is 44.85 feet above the datum of the gage. Bench mark No. 3 is the top of a vertical iron rod buried in the ground 4 feet east of mulberry tree near the left end of the bridge. Its elevation is 42.18 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Guadalupe River near Cuero, Tex., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
March 2	H. H. Fox	6.60	640
August 4 [a]	T. U. Taylor	6.10	540
October 23	do	6.10	407

[a] At San Antonio and Aransas Pass Railroad.

Mean daily gage height, in feet, of Guadalupe River near Cuero, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.70	6.60	6.50	6.45	9.98	7.65	6.18	6.05	6.43	6.52	6.70	6.20
2	6.70	6.60	6.60	6.40	7.75	7.35	6.25	6.00	6.43	6.62	6.60	6.20
3	6.75	6.70	6.60	6.45	7.63	6.90	6.65	6.05	6.30	6.67	6.60	6.20
4	6.70	6.60	6.55	8.75	8.80	6.75	6.70	6.00	6.05	6.55	6.45	6.50
5	6.80	6.60	6.50	8.20	11.00	6.65	7.60	6.05	6.22	6.40	6.45	6.50
6	6.70	6.70	6.50	7.00	18.60	6.95	6.85	5.80	6.32	6.45	6.30	6.55
7	6.70	6.60	6.55	6.80	20.78	7.22	6.85	5.85	6.40	6.40	6.20	6.40
8	6.70	6.65	6.50	6.65	11.38	7.15	6.75	6.00	6.10	6.62	6.20	6.20
9	6.80	6.65	6.50	6.58	14.18	7.75	6.20	7.85	7.55	6.15	6.15	6.35
10	6.70	6.60	6.50	6.48	11.38	7.57	6.05	7.20	7.40	6.37	6.05	6.20
11	6.70	6.60	6.50	6.48	9.38	7.30	6.20	6.50	6.75	6.05	6.10	6.20
12	6.75	6.65	6.40	6.43	8.20	7.50	5.95	6.25	6.57	6.37	6.10	6.20
13	6.70	6.70	6.40	6.43	7.78	7.05	6.00	6.15	6.47	6.30	6.10	6.20
14	6.70	6.65	6.55	6.33	7.50	6.88	5.80	6.20	6.52	6.15	6.10	6.20
15	6.70	6.65	6.45	6.38	7.38	6.68	5.95	6.25	10.90	6.60	6.10	6.20
16	6.70	6.70	6.45	6.35	7.40	6.55	6.05	6.25	16.95	6.37	6.10	6.20
17	6.60	6.70	6.45	6.25	7.38	6.55	5.95	6.15	11.10	6.37	6.10	6.20
18	6.70	6.70	6.40	6.53	9.65	6.58	6.15	6.35	11.25	6.62	6.10	6.10
19	6.70	6.70	6.45	6.33	12.45	6.60	6.10	6.25	8.37	6.62	6.10	6.10
20	6.70	6.65	6.60	6.20	11.83	6.50	6.10	6.30	7.37	6.60	6.05	6.10
21	6.80	6.70	6.50	6.33	7.78	6.55	6.05	6.25	7.37	6.52	6.10	6.10
22	6.70	6.70	6.50	6.28	7.20	6.55	6.00	6.20	8.10	6.47	6.10	6.10
23	6.70	6.80	6.50	6.38	7.05	6.60	5.95	6.15	8.35	6.25	6.10	6.20
24	6.60	6.70	6.45	6.18	6.90	7.30	6.05	6.05	7.85	6.35	6.20	6.20
25	6.70	6.70	6.45	6.38	7.00	9.20	6.05	6.15	6.90	6.65	6.20	6.20
26	6.60	6.70	6.45	6.45	6.85	7.40	6.05	6.00	6.60	10.85	6.20	20.15
27	6.70	6.70	6.35	6.43	6.75	6.75	6.10	6.00	6.55	14.35	6.20	11.80
28	6.60	6.70	6.45	6.48	6.85	6.60	6.00	6.20	6.70	10.15	6.20	14.15
29	6.65	6.60	6.30	6.45	7.10	6.50	5.90	6.74	6.65	8.10	6.20	9.10
30	6.70	.....	6.30	6.33	7.10	6.48	5.90	6.60	6.67	7.50	6.20	9.00
31	6.60	.....	6.45	.....	7.75	.....	5.85	6.30	.....	7.15	.....	16.65

Rating table for Guadalupe River near Cuero, Tex., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
5.80	465	8.10	1,133	11.80	2,426	20.00	6,340
5.90	490	8.20	1,166	12.00	2,500	21.00	7,040
6.00	515	8.30	1,199	12.20	2,574	22.00	7,840
6.10	540	8.40	1,232	12.40	2,650	23.00	8,680
6.20	566	8.50	1,265	12.60	2,726	24.00	9,630
6.30	592	8.60	1,298	12.80	2,803	25.00	10,690
6.40	619	8.70	1,332	13.00	2,881	26.00	11,840
6.50	646	8.80	1,366	13.20	2,959	27.00	13,070
6.60	673	8.90	1,400	13.40	3,038	28.00	14,370
6.70	701	9.00	1,434	13.60	3,118	29.00	15,730
6.80	729	9.20	1,502	13.80	3,198	30.00	17,200
6.90	758	9.40	1,570	14.00	3,280	31.00	18,950
7.00	787	9.60	1,640	14.50	3,487	32.00	21,000
7.10	817	9.80	1,710	15.00	3,700	33.00	23,320
7.20	847	10.00	1,780	15.50	3,920	34.00	26,000
7.30	878	10.20	1,850	16.00	4,150	35.00	29,690
7.40	909	10.40	1,920	16.50	4,400	36.00	34,200
7.50	940	10.60	1,992	17.00	4,650	38.00	44,800
7.60	972	10.80	2,064	17.50	4,900	40.00	55,400
7.70	1,004	11.00	2,136	18.00	5,150	43.00	71,300
7.80	1,036	11.20	2,208	18.50	5,440		
7.90	1,068	11.40	2,280	19.00	5,740		
8.00	1,100	11.60	2,352	19.50	6,040		

The above table is based upon 21 discharge measurements made during 1903 and 3 low-water measurements made in 1904. It is well defined.

NOTE.—There has been a slight change in stream bed, beginning the latter part of 1903 and extending over low-water periods in 1904. The 1903 curve below gage height, 17 feet, has been changed to conform to the 1904 measurements.

Estimated monthly discharge of Guadalupe River near Cuero, Tex., for 1904.

[Drainage area, 5,100 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	729	673	700	43,040	0.137	0.158
February	729	673	691	39,750	.135	.146
March	673	592	639	39,290	.125	.144
April	1,349	560	671	39,930	.132	.147
May	6,886	715	1,639	100,800	.321	.370
June	1,502	641	794	47,250	.156	.174
July	972	465	569	34,990	.112	.129
August	1,052	465	585	35,970	.115	.133
September	4,625	527	1,032	61,410	.202	.225
October	3,424	527	839	51,590	.165	.190
November	701	527	570	33,920	.112	.125
December	6,445	540	1,095	67,330	.215	.248
The year	6,886	465	819	595,300	.161	2.20

COMAL RIVER AT NEW BRAUNFELS, TEX.

Comal River has been fully described in Water-Supply Papers Nos. 71 and 105. It is formed by numerous big springs that issue from the foothills west of the town of New Braunfels, Tex., and the joint discharge of these form Comal River, which is formed by Comal Springs Creek and Comal Creek. The water from the head springs naturally flows down Comal Springs Creek, but a gravel dam deflects part of this flow into the Landa mill race. These waters again join about a fourth of a mile above the highway bridge north of the courthouse, forming Comal River. The following table shows the result of current meter measurements on Comal River at various times.

Discharge measurements of Comal River at New Braunfels, Tex., 1895–1904.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
1895	C. C. Babb	328	At highway bridge.
1898	T. U. Taylor	320	Do.
1899	do	310	In park.
1900	do	374	Do.
1901	do	343	Do.
1902	do	333	Do.
1903	do	412	In park (recent rains).
1904	do	375	In park.

SAN ANTONIO RIVER DRAINAGE BASIN.

SAN ANTONIO RIVER AT SAN ANTONIO, TEX.

San Antonio River began failing in 1885, and by 1895 the flow above the city in the park had entirely ceased. But like many of the other big springs of the Edwards Plateau it has gone through experience. There is no doubt about the river and the artesian wells having the same underground source, but the river regained its former efficiency in 1900, shortly after the celebrated flood (Water-Supply Paper No. 105), but in two years the discharge had dropped to a depth of the discharge of 1900.

The following table shows the list of discharge measurements that have been made on this stream:

Discharge measurements of San Antonio River at San Antonio, Tex., 1895–1904.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
December, 1895	C. C. Babb	49	Upper canal.
November, 1896	do	41	Do.
December, 1897	T. U. Taylor	0	Lower canal.
December, 1897	do	11	Hot wells.
March, 1898	do	0	Lower canal.
March, 1898	do	9	Hot wells.
June, 1899	do	10	Do.
June, 1899	do	0	Lower canal.
September, 1900	do	125	Hot wells.
September, 1900	do	103	Lower canal.
October, 1901	do	41	Hot wells.
March, 1904	do	65	Do.
June, 1904	do	61	Do.

NUECES RIVER DRAINAGE BASIN.

LEONA RIVER AT UVALDE, TEX.

The flow of the Leona at Uvalde is a very variable factor, and it has often occurred that it has stopped flowing altogether near Uvalde. It was dry in 1885, but soon revived and continued flowing till 1893, when it again ceased flowing for a time. Its history at the brickyard crossing, 1½ miles below town on the road to Pearsall, is given in the following table:

Discharge measurements of Leona River at Uvalde, Tex., 1885–1904.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
1885			Had flow.
1893			No flow.
December, 1895	C. C. Babb	11	
June, 1899	T. U. Taylor		Do.
September, 1900	do	5	
March, 1904	do	22	

RIO GRANDE DRAINAGE BASIN.

The Rio Grande rises in southern Colorado, in the Rocky Mountains, flows south through New Mexico and thence southeast, forming the boundary between Texas and Mexico. Pecos River, which rises in northern New Mexico and flows south across eastern New Mexico and western Texas, is its longest tributary from the north, although Devils River delivers to the Rio Grande about the same amount of water as does the Pecos. Conchos River is its principal tributary from the Mexican side. The determination of the amount of water in the Rio Grande is of importance, both on account of its use in irrigation and from its bearing upon interstate and international distribution of water. Most of the New Mexico and Texas stations are maintained by the International (Water) Boundary Commission. The data are collected by W. W. Follett, consulting engineer for the commission, and have been furnished through the courtesy of Gen. Anson Mills, commissioner. On account of the shifting character of the river beds at the International (Water) Boundary stations, no rating tables have been prepared. The estimated monthly discharges are from daily discharges computed by Mr. Follett directly from the discharge measurements.

RIO GRANDE NEAR DEL NORTE, COLO.

Measurements and observations were first begun in the vicinity of Del Norte in 1889 by George T. Quinby. The object of the measurements was to obtain the flow of the river before water was diverted for the agricultural region of San Luis Valley, and by a comparison of this with the figures obtained at Embudo to acquire data as to the effect of the numerous ditches taking out water between the two points. The river 25 miles above Del Norte flows out of the canyon at Wagon Wheel Gap. Little water, however, is diverted until the edge of the San Luis Valley is reached, the largest canal heading near the town of Del Norte. During freshets the river divides into a number of channels, making it difficult to obtain measurements near town. In order to avoid the expense of establishing a station during time of high water the first measurements—those about June 1—were made from several bridges crossing the numerous branches. The results were not wholly satisfactory, and on June 25 a station was established above the branches. Later a locality about 2 miles farther up was chosen.

The station is about 2 miles west of the town of Del Norte, above the main canal, taking water from the Rio Grande, and is above all the irrigating ditches of importance. The river flows in one channel, about 175 feet wide and of very regular section. The banks on each side are steep, and the water is reported never to overflow. The course of the stream is straight for 100 yards both above and below the section. The old inclined gage was set at an angle of about 30° to the horizontal on the right bank. On April 1, 1904, a new gage was placed in the same position and at the same datum as the old gage. As noted on October 10, 1891, bench mark No. 1 is a large nail in the root of a tree 15 feet northwest of the end of the cable on right bank of river. Bench mark No. 2 is a large nail in the root of a tree 25 feet southwest of the end of the inclined gage. Both bench marks are 7.54 feet above the datum of the gage.

On June 16, 1900, the gage rod was connected with an iron bench mark of the U. S. Geological Survey set in the ground about 25 feet south of the rod; the zero of the rod is 8.25 feet below the bench mark.

Gagings were first made from a flatboat, 4 feet wide and 14 feet long, attached by rope and tackle to a ⅜-inch wire cable fastened to a large cottonwood tree on the left bank and to a sand anchor on the right bank. They are now made by means of a car which travels across the river along a steel cable, the distance being marked on a tag wire. The channel is excellent, the water, although falling rapidly, seldom scouring, and the bed therefore remaining practically the same from year to year. The bed of the channel is covered with small bowlders, and the sides, although not high, have never been known to overflow. The observer is Richard Adams.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Rio Grande near Del Norte, Colo., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 1	G. B. Monk	93	2.25	1.15	209
May 5	do	175	3.33	1.80	584
June 20	do	196	3.51	1.90	687
June 25	do	188	3.29	1.85	618
July 14	do	111	2.33	1.40	259
July 20	do	108	2.27	1.30	245
July 30	do	141	2.99	1.70	420
August 22	do	179	3.27	1.99	585
August 22	do	179	3.12	1.98	558
August 23	do	164	2.98	1.90	488
August 23	do	170	3.53	1.90	598

Mean daily gage height, in feet, of Rio Grande near Del Norte, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.15	2.25	2.20	1.70	1.80	2.60	3.60
2	1.25	2.25	2.20	1.70	1.90	2.50	3.10
3	1.26	2.50	2.10	1.65	1.85	2.38	2.90
4	1.25	1.85	2.50	1.60	1.88	2.35	2.70
5	1.31	1.80	2.00	1.58	1.95	2.20	2.60
6	1.35	1.80	2.00	1.51	1.80	2.10	2.70
7	1.35	2.10	2.00	1.50	1.75	2.10	3.60
8	1.31	2.40	2.20	1.49	1.80	2.00	4.00
9	1.31	2.30	2.25	1.46	1.85	1.96	4.35
10	1.39	2.50	2.20	1.45	1.75	1.90	3.85
11	1.50	2.70	2.10	1.45	1.80	1.90	3.60
12	1.65	3.00	2.10	1.46	1.85	1.85	3.50
13	1.91	3.35	2.10	1.41	1.90	1.85	3.30
14	2.50	3.40	2.00	1.40	1.90	1.80	3.25
15	2.20	2.95	2.00	1.35	1.90	1.75	3.15
16	2.50	2.85	2.00	1.32	1.88	1.80	3.00
17	2.40	2.65	2.10	1.35	1.85	1.80	2.90
18	2.45	3.00	2.10	1.39	2.30	1.75	2.80
19	2.55	3.25	2.50	1.33	2.35	1.70	2.70
20	2.35	3.50	1.95	1.30	2.20	1.70	2.60
21	2.20	2.75	1.95	1.31	2.50	1.70	2.60
22	1.95	2.70	2.50	1.33	2.00	1.70	2.50
23	1.85	2.75	2.00	1.48	1.95	1.90	2.40
24	1.75	2.75	1.95	1.39	2.00	2.10	2.35
25	1.80	2.65	1.85	1.50	2.00	1.95	2.35
26	2.30	2.60	1.75	1.50	2.20	1.90	2.20
27	2.65	2.50	1.80	1.52	2.25	1.90	2.15
28	2.94	2.40	1.80	1.50	2.20	1.90	2.10
29	2.75	2.30	1.75	1.49	2.15	2.50	2.50
30	2.40	2.30	1.70	1.70	2.50	2.90	2.00
31	.....	2.30	.....	1.72	2.50	.....	2.00

Rating table for Rio Grande near Del Norte, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.15	195	1.90	605	2.70	1,225	3.50	2,040
1.20	210	2.00	675	2.80	1,315	3.60	2,160
1.30	245	2.10	745	2.90	1,410	3.70	2,280
1.40	290	2.20	815	3.00	1,510	3.80	2,400
1.50	345	2.30	890	3.10	1,610	3.90	2,520
1.60	405	2.40	970	3.20	1,710	4.00	2,640
1.70	465	2.50	1,050	3.30	1,810		
1.80	535	2.60	1,135	3.40	1,920		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is not well defined.

Estimated monthly discharge of Rio Grande near Del Norte, Colo., for 1904.

[Drainage area, 1,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,450	195	652	38,800	0.466	0.520
May	2,040	535	1,158	71,200	.827	.953
June	1,050	465	716	42,600	.511	.570
July	479	245	336	20,660	.240	.277
August	1,050	500	683	42,360	.492	.567
September	1,410	465	692	41,180	.494	.551
October	3,100	675	1,449	89,090	1.04	1.20
The period				345,900		

RIO GRANDE NEAR LOBATOS, COLO.

This station was located on June 28, 1899, by A. L. Fellows. It is at the State bridge across the Rio Grande, at a point near the Colorado-New Mexico State line and about 10 miles east of Lobatos, Colo. The station is favorably located for the purpose, the cross section being fairly uniform, the channel regular and not liable to overflow. There are two gages, one for high water and the other for low water. The high-water gage is a scale graduated to feet and tenths marked with white paint on the central downsteam cylinder of the bridge. The low-water gage is a scale, marked in feet and tenths, on the perpendicular face of a large bowlder about a hundred yards below the bridge. The channel is in most respects an excellent one. The bed consists of bowlders and rock, and is subject to little change; the banks are high and are not subject to overflow; one channel except at very low stages. Gagings can be made at the bridge, but during low water they are usually made by wading. On June 22, 1900, both gages were referred to a bench mark consisting of a chiseled point marked "B. M." on the face of the lava bluff under the west end of the bridge 7.42 feet above gage datum. The station is an extremely important one, giving, as it does, the discharge of the river at the Colorado State line, including practically all of the Colorado drainage. Roman Mondragon, a storekeeper at the west end of the bridge, has kept the records during the last year.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Rio Grande near Lobatos, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square ft.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
May 4	G. B. Monk	42	26	0.92	0.80	24
May 13	do	42	25	1.00	.80	25
May 26	do	41	20	.70	.70	14
June 9	do	41	20	.75	.70	16
June 18	do	47	27	1.04	.80	28
June 27	do	41	20	.80	.70	16
July 21	do	41	20	.70	.70	14
July 29	do	38	20	.70	.70	14
August 24	do	60	51	2.37	1.20	121

Mean daily gage height, in feet, of Rio Grande near Lobatos, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.60	1.60	1.60	0.90	0.70	0.70	0.70	0.70	1.40	2.90	2.10	0.9
2	1.60	1.60	1.60	.90	.70	.70	.70	.70	1.40	3.00	2.00	.9
3	1.60	1.60	1.50	.90	.70	.70	.70	.70	1.60	2.95	2.00	.9
4	1.60	1.60	1.40	.90	.80	.70	.70	.75	1.80	3.00	.90	2.0
5	1.60	1.60	1.40	.90	.80	.70	.70	.80	1.85	2.90	.90	2.0
6	1.60	1.60	1.30	.90	.80	.75	.70	.90	1.80	2.70	.90	2.0
7	1.60	1.60	1.20	.90	.80	.70	.70	.90	1.75	2.60	.90	2.0
8	1.60	1.70	1.20	.90	.80	.75	.70	.90	1.70	2.90	.90	2.0
9	1.60	1.50	1.20	.90	.80	.85	.70	1.55	1.55	3.30	.90	2.0
10	1.60	1.60	1.10	.90	.80	.80	.70	2.20	1.50	3.75	.90	2.10
11	1.60	1.60	1.10	.90	.80	.80	.90	.90	1.50	3.95	1.45	2.10
12	1.60	1.60	1.10	.80	.80	.80	.90	.90	1.35	3.95	1.45	2.20
13	1.60	1.60	1.10	.80	.80	.80	.80	.90	1.30	3.70	2.00	2.20
14	1.60	1.60	1.10	.90	.80	.80	.70	.90	1.30	3.50	2.00	2.35
15	1.60	1.60	1.10	.90	.80	.80	.70	.90	1.20	3.20	2.00	2.40
16	1.60	1.60	1.10	.90	.90	.80	.70	.90	1.20	3.20	2.00	2.45
17	1.60	1.90	1.10	2.00	.80	.80	.70	.90	1.20	3.00	2.00	2.50
18	1.60	1.90	1.10	2.00	.85	.80	.70	1.90	1.20	3.00	2.00	2.60
19	1.60	2.00	1.10	2.20	.80	.80	.70	1.90	1.20	2.90	2.00	2.60
20	1.60	2.10	1.10	2.10	.80	.80	.70	2.05	1.20	2.80	2.00	2.60
21	1.60	2.10	1.10	2.00	.70	.80	.70	1.00	1.10	2.60	2.00	2.60
22	1.60	2.10	1.20	2.00	.75	.80	.70	1.00	1.10	2.60	2.00	2.60
23	1.60	2.10	1.20	.90	.70	.70	.90	1.00	1.10	2.50	2.00	2.60
24	1.60	2.00	1.20	.80	.70	.70	.70	1.10	1.10	2.50	2.00	2.60
25	1.60	2.00	1.20	.80	.70	.70	.70	1.20	1.10	2.40	2.00	2.60
26	1.60	1.90	1.20	.80	.70	.70	.70	1.20	1.10	2.20	2.00	2.60
27	1.60	1.90	1.20	.80	.70	.70	.70	1.15	1.10	2.20	2.00	2.60
28	1.60	1.80	1.00	.80	.70	.70	.70	1.20	1.10	2.10	2.00	2.60
29	1.60	1.70	1.00	.80	.70	.70	.70	1.20	1.20	2.10	2.00	2.60
30	1.60	.....	1.00	.70	.70	.70	.70	1.15	1.50	2.10	.90	2.60
31	1.60	.....	.90	.....	.70	.....	.70	1.40	.....	2.10	.....	2.60

Rating table for Rio Grande near Lobatos, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	14	1.60	306	2.50	1,062	3.40	2,345
.80	26	1.70	366	2.60	1,181	3.50	2,500
.90	42	1.80	432	2.70	1,308	3.60	2,655
1.00	62	1.90	503	2.80	1,443	3.70	2,810
1.10	88	2.00	580	2.90	1,585	3.80	2,965
1.20	121	2.10	662	3.00	1,732	3.90	3,120
1.30	159	2.20	751	3.10	1,882	4.00	3,275
1.40	203	2.30	847	3.20	2,035		
1.50	252	2.40	951	3.30	2,190		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1900 to 1904, inclusive. It is well defined between gage heights 0.70 foot and 2.00 feet. Above gage height 2.00 feet the curve is not well defined. Above gage height 3.20 feet the rating curve is a tangent, the difference being 155 per tenth.

Estimated monthly discharge of Rio Grande near Lobatos, Colo., for 1904.

[Drainage area, 7,695 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	306	306	306	18,820	0.040	0.046
February	662	252	417	23,990	.054	.058
March	306	42	123	7,563	.016	.018
April	751	14	153	9,104	.020	.022
May	42	14	21.5	1,322	.0028	.0032
June	34	14	20.3	1,208	.0026	.0029
July	42	14	17.5	1,076	.0023	.0027
August	751	14	140	8,608	.018	.021
September	468	88	196	11,660	.025	.028
October	3,198	662	1,590	97,770	.207	.239
November	662	42	416	24,750	.054	.060
December	1,181	42	867	53,310	.113	.130
The year	3,198	14	356	259,200	.046	.631

RIO GRANDE NEAR SAN ILDEFONZO, N. MEX.

Three miles below Embudo the Rio Grande emerges into Espanola Valley, through which it continues for a few miles and then enters White Rock Canyon, flowing through that canyon for 30 miles. At the lower end of this canyon the river emerges into Albuquerque Valley, and so continues down to about Socorro. This valley averages from 1 to 3 miles in width, and has been irrigated for a great many years by the Mexican settlers. Their primitive methods of irrigation are very wasteful of the waters, so that the duty of water in this section—about 17 acres per second-foot—is not as high as it might be. During the last few years, however, a number of important and modern irrigation systems have been planned and built in the vicinity of Albuquerque. The gaging station, established February 3, 1895, is located on the Denver and Rio Grande Railroad bridge over the Rio Grande, about 9 miles below Espanola. It was established by A. P. Davis and P. E. Harroun. It has been called by the following names: Rio Grande, Buckman, and Water Tank. The original gage at this station was located on the left bank, 180 feet above the bridge. It was made in two sections and graduated to feet and tenths. The inclined portion read from 1 to 10 feet and the vertical portion from 10 to 16 feet. It was found that this gage was not well located, and on March 30, 1904, a vertical rod was established by M. C. Hinderlider on the downstream side of the north pier of the bridge. This

is known as the new gage, and all the discharge measurements made in 1904 are referred to it. During the flood of September, 1904, this rod was cut off from the water by the filling in of the channel. On October 29, 1904, a standard chain gage was established by George B. Monk on the downstream running-board of the bridge, at the same datum as the new rod gage. Length of chain from marker to lower end of weight is 23.28 feet. The gage is read twice each day by A. L. Martinez. During 1904 the changes in the channel made it necessary for him to use first the old rod and then the new rod at irregular intervals. The 1903 rating table should be applied to all the observations on the old gage. The 1904 table should be used on all observations on the new gage. The discharge measurements are made from a cable 200 feet above the bridge, except during very high water, when the bridge is used. The initial point for soundings is at the end of the cable on the left bank, where it is fastened to two small trees. The channel is straight for 150 feet above and for 300 feet below the station. The current is swift, and there is but one channel at high and low water. The right bank is low and wooded. The left bank is high, rocky, and wooded. Neither bank is subject to overflow. The cable has a span of 220 feet. The bed of the stream is sandy and free from vegetation, with a few bowlders near the left bank. The bed of the stream shifts rapidly from day to day, but the relation between area, velocity, and gage height is believed to be nearly constant except under very unusual conditions.

The bench mark for the new gage is a United States Geological Survey tablet set in the top of a granite bowlder 5 feet square and 2 feet high, located in a clump of cedars on the right bank of the river about 75 feet from the west end of the north pier of the railroad bridge. The bench mark is 11.37 feet above the zero of the new gage. The zero of the old gage is 2.019 feet lower than the zero of the new gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Rio Grande near San Ildefonzo, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Feet.	*Sq. feet.*	*Feet per sec.*	*Feet.*	*Second ft.*
April 30	G. B. Monk	54	165	3.19	2.30	526
May 7	do	50	147	2.84	2.00	418
May 18	do	55	152	2.72	2.05	413
May 28	do	50	140	2.84	1.90	398
June 6	do	49	119	2.77	1.50	330
June 14	do	46	111	1.66	1.40	184
June 29	do	47	117	1.74	1.50	203
July 16	do	42	52	1.48	1.20	77
July 23	do	70	174	3.57	2.55	621
August 27	do	115	197	3.67	3.10	723
August 27	do	115	197	3.25	3.04	640
October 4	do	120	397	6.54	4.00	2,596
October 5	do	120	436	5.83	4.00	2,541
October 7	do	128	445	5.57	3.90	2,478
October 7	do	128	471	5.39	4.10	2,540
October 17	do	126	518	5.63	4.50	2,916
October 28	do	96	314	4.07	3.30	1,281
November 7	do	92	221	3.47	2.80	767

[a] Gage heights refer to new rod.

Mean daily gage height, in feet, of Rio Grande near San Ildefonzo, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.85	3.85	4.60	3.80	4.25	1.55	1.55	5.15	5.30	18.20	3.05	2.70
2	3.95	3.90	4.55	3.75	4.25	1.55	1.50	5.80	5.20	6.15	3.00	2.70
3	3.85	3.95	4.55	3.80	4.05	1.50	1.45	6.15	5.15	4.70	2.90	2.70
4	3.85	3.95	4.30	3.80	4.05	1.50	1.40	5.40	4.95	4.15	2.90	2.70
5	3.95	4.10	4.35	3.80	4.05	1.45	1.40	5.05	5.25	4.05	2.80	2.60
6	3.95	4.15	4.25	3.70	4.00	1.40	1.40	5.40	5.60	3.95	2.80	2.60
7	3.85	4.20	4.25	3.55	4.05	1.45	1.30	6.10	5.75	4.75	2.80	2.35
8	3.85	4.20	4.20	3.45	4.05	1.50	1.20	6.45	5.70	8.25	2.75	2.20
9	3.95	4.10	4.15	3.40	4.25	1.40	1.20	5.45	5.65	6.90	2.70	2.35
10	3.95	3.95	4.00	3.40	4.35	1.45	1.20	4.55	5.40	5.75	2.80	2.35
11	4.05	4.05	3.95	3.30	4.25	1.40	1.20	4.60	5.25	5.50	2.80	2.35
12	4.10	4.05	3.95	3.30	4.25	1.45	1.10	4.25	5.10	5.50	2.80	2.25
13	4.15	4.15	4.00	3.35	4.20	1.55	1.10	4.10	5.15	5.45	2.70	2.20
14	4.05	4.10	3.90	3.70	4.15	1.60	1.10	4.10	5.00	5.15	2.65	2.25
15	3.90	4.10	3.90	5.00	4.25	1.60	1.20	6.05	5.00	5.45	2.70	2.35
16	4.10	4.10	3.85	5.20	4.25	1.75	2.05	5.95	4.95	4.75	2.80	2.35
17	4.10	4.20	3.85	5.15	4.25	1.95	1.30	6.00	4.85	4.50	2.80	2.25
18	4.10	4.30	3.70	5.10	4.25	2.05	1.30	7.45	4.70	4.35	2.90	2.35
19	4.10	4.35	3.60	5.10	2.15	1.90	1.30	7.45	4.75	4.15	2.90	2.40
20	4.05	4.35	3.60	5.15	2.05	2.00	1.70	6.45	7.35	4.00	2.80	2.40
21	3.95	4.30	3.70	4.70	2.00	2.15	1.45	5.85	7.10	3.85	2.80	2.40
22	3.85	4.30	3.75	4.95	2.05	2.30	1.65	5.20	5.45	3.85	2.75	2.40
23	3.95	4.25	3.80	4.55	2.05	2.10	2.60	4.95	6.10	3.80	2.80	2.45
24	4.05	4.35	3.85	4.45	2.05	1.85	2.85	4.95	7.75	3.65	2.70	2.45
25	3.85	4.45	3.80	4.30	2.05	1.70	5.00	5.95	7.80	3.60	2.70	2.45
26	3.85	4.55	3.75	4.30	1.95	1.55	4.60	6.65	10.45	3.50	2.70	2.35
27	3.80	4.60	3.70	4.45	1.85	2.25	3.80	6.25	10.70	3.40	2.75	2.30
28	3.90	4.55	3.65	4.40	1.85	2.05	3.80	5.55	10.70	3.30	2.80	2.15
29	3.80	4.55	3.60	4.45	1.80	1.65	3.50	5.30	12.10	3.35	2.80	2.05
30	3.80	.....	3.60	4.40	1.65	1.75	3.45	4.80	9.95	3.35	2.75	2.15
31	3.90	.....	3.75	.....	1.65	.....	3.75	6.00	.....	3.10	.....	2.25

NOTE.—Gage heights referred to new gage May 19 to July 24 and October 2 to December 31. Gage heights referred to old gage January 1 to May 18 and July 25 to October 1.

Rating table for Rio Grande near San Ildefonso, N. Mex., from August 1, 1903, to May 18, 1904, and July 25 to October 1, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	190	4.40	485	5.50	1,210	6.60	2,640
3.40	210	4.50	520	5.60	1,340	6.70	2,770
3.50	230	4.60	560	5.70	1,470	6.80	2,900
3.60	250	4.70	600	5.80	1,600	6.90	3,030
3.70	275	4.80	645	5.90	1,730	7.00	3,160
3.80	300	4.90	695	6.00	1,860	7.20	3,420
3.90	325	5.00	755	6.10	1,990	7.40	3,680
4.00	355	5.10	825	6.20	2,120	7.60	3,940
4.10	385	5.20	905	6.30	2,250	7.80	4,200
4.20	415	5.30	995	6.40	2,380	8.00	4,460
4.30	450	5.40	1,095	6.50	2,510		

The table is fairly well defined above 4.00 feet gage height. The table has been extended below 4.00 feet. The upper portion of the curve is determined by July discharge measurements made by the International (Water) Boundary Commission. Above gage height 5.50 feet the rating curve is a tangent, the difference being 130 per tenth. The table applies only between the dates given above.

Rating table for Rio Grande near San Ildefonso, N. Mex., from May 19 to July 24, and October 2 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	65	2.20	484	3.30	1,288	4.40	3,135
1.20	94	2.30	530	3.40	1,400	4.50	3,340
1.30	129	2.40	579	3.50	1,520	4.60	3,550
1.40	165	2.50	633	3.60	1,650	4.70	3,760
1.50	202	2.60	693	3.70	1,800	4.80	3,970
1.60	240	2.70	759	3.80	1,970	4.90	4,180
1.70	278	2.80	831	3.90	2,150	5.00	4,400
1.80	317	2.90	909	4.00	2,340	6.00	6,800
1.90	357	3.00	994	4.10	2,535		
2.00	398	3.10	1,085	4.20	2,730		
2.10	440	3.20	1,183	4.30	2,930		

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904. It is based on rather doubtful measurements, the channel shifting rapidly and is not well defined. It applies only to observations on the new rod between the dates given above.

Estimated monthly discharge of Rio Grande near San Ildefonso, N. Mex., for 1904.

[Drainage area, 14,050 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	400	300	340	20,910	0.024	0.028
February	560	310	421	24,220	.030	.032
March	560	250	347	21,340	.025	.029
April	905	190	459	27,310	.033	.037
May	465	259	393	24,160	.028	.032
June	530	165	286	17,020	.020	.022
July	870	62	246	15,130	.018	.021
August	3,745	385	1,496	91,990	.106	.122
September	9,790	600	2,493	148,300	.177	.198
October	17,700	1,085	4,111	252,800	.293	.338
November	1,040	726	831	49,450	.059	.066
December	759	419	576	35,420	.041	.047
The year	17,700	62	1,000	728,000	.071	.972

RIO GRANDE NEAR SAN MARCIAL, N. MEX.

This station is located about one-half mile south of San Marcial, N. Mex., at the bridge of the Atchison, Topeka and Santa Fe Railway. The original gage was established by Arthur P. Davis on January 29, 1895. The observer was Bert Halseth, San Marcial, N. Mex., who lives about one-half mile distant. The gage was of hard pine timber, 9 by 5 inches by 25 feet, anchored and bolted to the east end of the second pier from the south. It was inclined and painted white. The distance between the footmarks was 1.6 feet. The 13-foot mark was level with the extension of the pier, to which the gage was anchored. The 15-foot mark was level with the top of the capstone on which the bridge truss rests. Measurements were made from the same bridge. On August 8, 1889, a station was established near San Marcial, and a measurement was made which gave a discharge of 19 second-feet. Soon after this date, however, the river gage was destroyed and the locality was abandoned until 1895.

In 1896 the inclined gage was carried away and a wire gage was put in its place. The wire gage was attached to the guard rail of the bridge in the south span on the lower side. Bench mark No. 1 is the top of the capstone on which the bridge truss rests, and is at an elevation of 15.00 feet above gage datum; bench mark No. 2 is the top of the extension of the pier to which the old vertical gage was fastened.

and is at an elevation of 13.00 feet above gage datum. The wire gage has been abandoned and the gage heights are now measured with a graduated rod from the deck of the bridge, but using the old gage datum. The channel is sandy and shifting. A number of bridge piers interfere with the current to a certain extent, but not with the observed gage heights. They sometimes affect the discharge measurements.

Since January 1, 1901, this station has been maintained under the charge of the International (Water) Boundary Commission.

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 4 [a]	J. R. Nisbet	127	2.46	7.8	313
January 12 [a]	do	116	2.57	8.0	298
January 16 [a]	do	110	2.30	8.0	253
January 31	do	124	2.46	7.8	305
February 4	do	133	2.27	7.8	302
February 8	do	135	2.32	8.0	313
February 12	do	168	2.16	7.9	363
February 17	do	163	2.03	7.7	331
February 21	do	153	2.06	7.8	315
February 25	do	183	1.91	7.8	350
February 29	do	144	2.06	7.8	296
March 4	do	149	2.01	7.9	300
March 7	do	110	1.84	7.9	202
March 10	do	59	1.56	7.4	92
March 13	do	49	1.57	7.2	77
March 16	do	39	1.56	6.9	61
March 19	do	27	0.96	6.4	26
July 23	do	367	2.54	8.75	932
July 23	do	1,116	2.55	10.65	2,841
July 25	do	140	2.51	7.9	352
July 25	G. B. Monk	138	2.11	7.8	291
July 28	J. R. Nisbet	230	2.15	8.2	495
July 31	do	84	2.15	7.3	181
August 2	do	210	2.91	7.85	612
August 5	do	429	3.86	9.4	1,656
August 7	do	351	3.87	9.2	1,357
August 10	do	242	2.69	8.2	651
August 13	do	83	2.27	7.2	188
August 16	do	32	1.59	6.6	51

[a] River full of floating ice.

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 23	C. E. Mead	153	3.99	9.5	610
September 26	do	129	3.50	8.6	452
September 28	do	440	5.75	10.2	2,529
October 1	do	1,270	6.89	12.0	8,753
October 3	do	3,342	[illegible]	11.75	13,368
October 7	do	840	[illegible].48	9.0	2,920
October 10	do	2,645	8.16	12.6	21,584
October 13	do	3,612	6.10	9.55	22,048
October 17	do	470	3.41	8.7	1,602
October 21	do	404	4.29	8.2	1,734
October 25	do	367	3.87	8.2	1,422
October 29	do	411	3.73	8.1	1,160
November 2	do	308	4.64	8.1	1,430
November 3	G. B. Monk	268	4.92	8.1	1318
November 5	C. E. Mead	267	3.70	8.0	[illegible]9
November 7	do	220	3.81	7.9	[illegible]
November 10	do	274	3.62	7.9	[illegible]1
November 12	do	242	3.60	7.9	872
November 15	do	241	3.23	7.9	[illegible]
November 17	do	187	3.68	7.8	
November 19	do	218	3.28	7.9	
November 22	do	216	3.79	8.0	818
November 24	do	196	3.61	8.0	7
November 26	do	207	3.36	8.0	6
November 30	do	211	3.10	8.0	6
December 2	do	241	2.74	8.0	6
December 5	do	250	3.78	8.1	9
December 8	do	265	3.09	8.0	820
December 11	do	222	4.44	7.9	98
December 14	do	228	3.50	7.8	78
December 17	do	219	2.40	7.8	52
December 23	do	241	2.38	7.9	57
December 28 [a]	do	198	2.08	7.8	41
December 31 [a]	do	167	2.14	7.7	357

[a] Ice in river.

Mean daily gage height, in feet, of Rio Grande near San Marcial, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.7	7.7	7.9	.....	.....	.....	.....	7.85	8.75	11.95	8.2	8.0
2	7.7	7.8	7.9	.....	.....	.....	.....	7.65	8.8	13.1	8.1	8.0
3	7.7	7.9	7.9	.....	.....	.....	.....	8.35	9.0	12.7	8.1	8.0
4	7.7	7.8	7.9	.....	.....	.....	.....	8.65	8.8	9.5	8.1	8.0
5	7.55	7.95	7.9	.....	.....	.....	.....	9.7	8.3	8.9	8.0	8.1
6	7.8	8.0	7.95	.....	.....	.....	.....	9.2	7.8	8.6	8.0	8.25
7	7.7	8.0	7.9	.....	.....	.....	.....	9.15	7.35	9.1	7.9	8.1
8	7.6	8.0	7.9	.....	.....	.....	.....	8.9	7.15	8.95	7.9	8.0
9	7.75	8.1	7.8	.....	.....	.....	.....	8.35	6.95	11.55	8.0	8.1
10	7.75	8.0	7.4	.....	.....	.....	.....	8.35	6.75	12.85	7.9	8.1
11	7.85	8.0	7.5	.....	.....	.....	.....	8.25	.....	13.75	7.9	7.9
12	8.0	7.9	7.4	.....	.....	.....	.....	8.0	.....	10.6	7.9	7.8
13	7.8	7.8	7.3	.....	.....	.....	.....	7.5	.....	9.45	7.8	7.8
14	7.8	7.8	7.2	.....	.....	.....	.....	7.3	.....	9.0	7.8	7.8
15	7.9	7.8	7.1	.....	.....	.....	.....	6.85	.....	8.9	7.9	7.9
16	8.0	7.8	6.9	.....	.....	.....	.....	6.6	.....	8.75	7.8	7.9
17	7.95	7.7	6.8	.....	.....	.....	.....	6.4	.....	8.65	7.8	7.8
18	7.95	7.7	6.6	.....	.....	.....	.....	7.45	.....	8.65	7.8	7.9
19	7.95	7.7	6.4	.....	.....	.....	.....	8.45	.....	8.55	7.9	7.9
20	8.05	7.7	(a)	.....	.....	.....	.....	9.0	.....	8.4	8.0	7.9
21	8.2	7.8	.....	.....	.....	.....	.....	8.1	7.95	8.2	8.0	7.85
22	8.05	7.85	.....	.....	.....	.....	(a)	9.05	7.95	8.3	8.0	7.8
23	8.0	7.8	.....	.....	.....	.....	8.9	9.35	9.1	8.25	8.0	7.9
24	7.95	7.85	.....	.....	.....	.....	8.85	8.9	9.0	8.1	8.0	7.9
25	7.9	7.8	.....	.....	.....	.....	8.1	8.8	9.35	8.15	8.0	7.8
26	7.9	7.85	.....	.....	.....	.....	8.45	8.95	8.6	8.25	8.0	7.8
27	7.8	7.8	.....	.....	.....	.....	8.9	9.45	9.1	8.1	8.1	7.8
28	7.25	7.8	.....	.....	.....	.....	8.2	9.8	10.4	8.1	8.1	7.8
29	7.25	7.8	.....	.....	.....	.....	7.45	8.8	10.5	8.1	8.0	7.8
30	7.7	.....	.....	.....	.....	.....	7.2	8.5	11.7	8.1	8.0	7.75
31	7.8	.....	.....	.....	.....	.....	7.3	8.45	.....	8.25	.....	7.7

(a) No flow from March 19 to July 23.

Mean daily discharge, in second-feet, of Rio Grande near San Marcial, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.[a]	May.[a]	June.[a]	July.[b]	Aug.	Sept.	Oct.	Nov.	Dec.
1	300	270	330	.....	.....	.....	.....	220	950	c8,550	1,330	660
2	300	300	320	.....	.....	.....	.....	c450	970	18,400	c1,430	c660
3	300	330	310	.....	.....	.....	.....	950	1,050	c19,070	1,330	660
4	c300	c300	c300	.....	.....	.....	.....	1,150	630	5,000	1,230	660
5	270	310	265	.....	.....	.....	.....	c2,110	630	3,200	c990	c945
6	310	315	245	.....	.....	.....	.....	1,360	380	2,600	990	1,130
7	290	315	c200	.....	.....	.....	.....	c1,320	200	c3,000	c840	945
8	270	c315	200	.....	.....	.....	.....	1,150	140	2,880	890	c820
9	280	360	180	.....	.....	.....	.....	760	80	12,000	1,040	1,010
10	280	355	c90	.....	.....	.....	.....	c760	40	c24,000	c990	1,100
11	290	375	110	.....	.....	.....	.....	680	0	33,000	930	c990
12	c300	c365	95	.....	.....	.....	.....	560	0	24,800	c870	880
13	260	350	c85	.....	.....	.....	.....	c330	0	c21,750	740	840
14	250	350	75	.....	.....	.....	.....	240	0	15,900	710	c800
15	250	350	70	.....	.....	.....	.....	110	0	11,100	c780	810
16	c250	350	c60	.....	.....	.....	.....	c50	0	6,250	690	720
17	250	c330	55	.....	.....	.....	.....	20	0	c1,550	c690	c525
18	260	320	40	.....	.....	.....	.....	310	0	1,710	690	620
19	270	310	c25	.....	.....	.....	.....	830	0	1,770	c720	610
20	310	300	.....	.....	.....	.....	.....	1,220	0	1,780	820	600
21	370	c315	.....	.....	.....	.....	.....	600	300	c1,730	820	550
22	315	335	.....	.....	.....	.....	.....	1,280	300	1,750	c820	500
23	300	335	.....	.....	.....	.....	c1,070	1,580	c530	1,620	770	c575
24	290	355	.....	.....	.....	.....	1,020	1,150	510	1,390	c710	565
25	280	c350	.....	.....	.....	.....	c490	1,080	580	c1,370	700	455
26	280	350	.....	.....	.....	.....	680	1,180	c450	1,430	c700	440
27	260	320	.....	.....	.....	.....	990	1,730	950	1,240	790	425
28	115	305	.....	.....	.....	.....	c500	2,260	c3,030	1,200	780	c410
29	115	c295	.....	.....	.....	.....	230	1,080	3,280	c1,160	660	410
30	270	.....	.....	.....	.....	.....	150	870	7,550	1,120	c650	380
31	c305	.....	.....	.....	.....	.....	c180	830	.....	1,230	.....	c355

[a] No flow during this month.
[b] No flow previous to the 22d.
[c] Meter measurements.

Estimated monthly discharge of Rio Grande near San Marcial, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	370	115	274	16,840
February	375	270	329	18,902
March	330	0	99	6,060
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	1,070	0	171	10,532
August	2,260	20	910	55,974
September	7,550	0	752	44,727
October	33,000	1,120	7,534	463,240
November	1,430	650	870	51,769
December	1,130	355	679	41,752
The year	33,000	0	968	709,796

RIO GRANDE NEAR EL PASO, TEX.

This station was located at the pumping house of the smelter company, 3 miles north of El Paso, Tex. The bed of the stream here is composed of mud, constantly shifting and changing. May 1, 1897, the station was placed under the charge of W. W. Follett, consulting engineer, International (Water) Boundary Commission, and by him removed 1 mile farther up the river, to Courchesne's limekiln. The river heights were measured at the masonry pump foundation pier, 150 feet above the kiln. The top of the downstream chisel draft on this pier was assumed to be at a gage height of 15.00 feet, and the distance of the surface of the water below it was measured with a carefully graduated rod. This pier was torn down in October, 1902, and an inclined wooden gage established some 60 feet upstream. This is a 2 by 4 inch timber bolted to 1¼-inch steel bars set with cement in holes drilled in solid rock. The graduations are notches cut in the scantling. The bench mark is a ½-inch iron bolt set in solid rock at the head of the gage. Its elevation is 13.00 feet above the zero of the gage. The left bank of the river is formed by the loose rock fill of the Atchison, Topeka and Santa Fe Railway embankment, and will not overflow. The right bank, however, is not so good, being made ground and subject to overflow. The bottom of the river here has also proved unstable, scouring on a rise and filling on a falling river. It is probably the best site for a station in the vicinity of El Paso, however, as the entire river bed is constantly shifting for many miles

above and below. On account of this shifting character of the stream, the only accurate method of estimating the daily discharges is by taking a large number of measurements.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Rio Grande near El Paso, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
August 10	T. M. Courchesne	221	2.62	5.8	579
August 12	do	175	1.78	5.2	311
August 14	do	137	1.57	4.9	215
August 16	do	89	1.26	4.4	112
August 18	do	35	.97	3.9	34
August 20	do	18	.83	3.6	15
August 25	do	59	1.25	4.2	74
August 27	do	172	1.75	5.4	301
August 30	do	136	1.48	5.0	201
September 3	do	135	1.51	5.2	204
September 12	do	35	1.06	4.2	37
September 15	do	174	1.68	5.5	293
September 17	do	44	1.07	4.4	47
September 24	do	46	1.04	4.4	48
September 26	do	44	1.09	4.4	48
September 28	do	137	1.53	5.2	210
September 30	do	199	2.15	5.9	428
October 3	do	1,478	3.77	10.95	5,577
October 5	do	1,630	4.27	12.2	6,965
October 6	do	1,725	4.62	12.7	7,969
October 10	do	2,272	5.01	13.3	11,372
October 12	do	2,289	5.25	13.4	12,010
November 7	do	398	2.49	7.4	990
November 11	do	381	2.03	7.0	774
November 12	do	384	2.35	7.0	[a]901
November 14	do	348	2.24	7.0	778
November 17	do	320	2.31	6.9	739
November 21	do	248	2.23	6.6	554
November 24	do	254	2.29	6.7	582
November 30	do	300	1.97	6.8	590
December 3	Valmore Courchesne	303	2.05	6.8	622
December 6	do	393	2.56	7.65	1,008
December 9	do	402	2.28	7.5	918
December 12	do	377	2.22	7.2	837

[a] Too large; not used in computing daily discharge.

Discharge measurements of Rio Grande near El Paso, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
December 15...	Valmore Courchesne .	301	2.06	6.8	620
December 18...	.....do	242	1.94	6.6	469
December 21...	.....do	253	1.93	6.6	489
December 24...	.....do	250	1.96	6.5	491
December 28...	.....do	243	1.72	6.4	417
December 31...	.....do	242	1.79	6.4	432

Mean daily gage height, in feet, of Rio Grande near El Paso, Tex., for 1904.

Day.	Jan.	Feb.	Mar.[a]	Apr.[a]	May.[a]	June.[a]	July.[a]	Aug.[a]	Sept.	Oct.	Nov.	Dec.
1	4.1	3.6	.....	.....	.....	.....	.....	.....	5.55	7.45	7.9	6.8
2	4.1	3.6	.....	.....	.....	.....	.....	.....	5.35	9.55	7.8	6.8
3	4.1	3.6	.....	.....	.....	.....	.....	.....	5.2	10.8	7.65	6.8
4	3.95	3.6	.....	.....	.....	.....	.....	.....	5.35	11.55	7.6	6.8
5	3.75	3.55	.....	.....	.....	.....	.....	.....	5.7	12.1	7.45	6.8
6	3.6	3.5	.....	.....	.....	.....	.....	.....	6.1	12.75	7.4	7.45
7	3.6	3.4	.....	.....	.....	.....	.....	.....	5.55	11.5	7.4	7.6
8	3.6	3.4	.....	.....	.....	.....	.....	(a)	4.9	11.1	7.3	7.6
9	3.5	3.4	.....	.....	.....	.....	.....	4.35	4.8	12.55	7.2	7.55
10	3.4	3.4	.....	.....	.....	.....	.....	5.6	4.7	13.3	7.1	7.5
11	3.4	3.4	.....	.....	.....	.....	.....	5.4	4.35	13.15	7.0	7.3
12	3.4	3.4	.....	.....	.....	.....	.....	5.35	4.2	13.4	7.0	7.2
13	3.4	3.4	.....	.....	.....	.....	.....	5.15	4.2	13.6	7.0	7.0
14	3.4	3.4	.....	.....	.....	.....	.....	4.85	5.3	13.9	7.0	7.0
15	3.4	3.4	.....	.....	.....	.....	.....	4.65	5.25	13.95	6.95	6.8
16	3.4	3.4	.....	.....	.....	.....	.....	4.35	4.5	11.35	6.9	6.7
17	3.4	3.4	.....	.....	.....	.....	.....	4.1	4.35	10.35	6.9	6.65
18	3.4	3.4	.....	.....	.....	.....	.....	3.85	4.05	9.85	6.95	6.6
19	3.4	3.4	.....	.....	.....	.....	.....	3.65	3.9	9.55	6.9	6.6
20	3.4	3.4	.....	.....	.....	.....	.....	3.55	3.7	9.25	6.8	6.6
21	3.4	3.4	.....	.....	.....	.....	.....	3.4	3.6	9.05	6.65	6.6
22	3.4	3.4	.....	.....	.....	.....	.....	3.25	3.6	8.8	6.6	6.6
23	3.4	3.4	.....	.....	.....	.....	.....	3.2	4.3	8.65	6.65	6.5
24	3.4	3.4	.....	.....	.....	.....	.....	3.6	4.6	8.5	6.7	6.5
25	3.4	3.4	.....	.....	.....	.....	.....	4.3	4.4	8.65	6.8	6.5
26	3.4	3.4	.....	.....	.....	.....	.....	4.8	4.4	8.35	6.9	6.5
27	3.5	3.4	.....	.....	.....	.....	.....	5.35	4.7	8.15	6.9	6.55
28	3.6	3.4	.....	.....	.....	.....	.....	5.0	5.35	8.0	6.9	6.4
29	3.6	3.4	.....	.....	.....	.....	.....	5.0	5.8	8.0	6.9	6.55
30	3.6	.....	.....	.....	.....	.....	.....	5.1	6.05	8.0	6.8	6.55
31	3.6	.....	.....	.....	.....	.....	.....	5.35	.....	7.9	.....	6.4

[a] No flow March 1 to August 8.

Mean daily discharge, in second-feet, of Rio Grande near El Paso, Tex., for 1904.

Day.	Jan.	Feb.	Mar.[a]	Apr.[a]	May.[a]	June.[a]	July.[a]	Aug.	Sept.	Oct.	Nov.	Dec.
1	75	15	.....	.....	.....	.....	.....	.....	380	1,790	1,490	600
2	75	15	.....	.....	.....	.....	.....	.....	280	1,040	1,390	610
3	70	15	.....	.....	.....	.....	.....	.....	[b]205	[b]5,410	1,240	[b]620
4	45	15	.....	.....	.....	.....	.....	.....	280	6,230	1,190	620
5	15	10	.....	.....	.....	.....	.....	.....	455	[b]6,850	1,040	620
6	15	10	.....	.....	.....	.....	.....	.....	655	[b]8,170	990	[b]890
7	15	5	.....	.....	.....	.....	.....	.....	380	6,180	[b]990	980
8	15	5	.....	.....	.....	.....	.....	.....	140	5,740	920	980
9	10	5	.....	.....	.....	.....	.....	105	120	7,670	860	[b]950
10	5	5	.....	.....	.....	.....	.....	[b]480	100	[b]11,370	810	920
11	5	5	.....	.....	.....	.....	.....	390	55	10,550	[b]770	870
12	5	5	.....	.....	.....	.....	.....	[b]370	[b]35	[b]12,010	770	[b]840
13	5	5	.....	.....	.....	.....	.....	290	35	13,800	780	730
14	5	5	.....	.....	.....	.....	.....	[b]205	245	16,200	[b]780	730
15	5	5	.....	.....	.....	.....	.....	165	[b]230	17,100	760	[b]630
16	5	5	.....	.....	.....	.....	.....	[b]105	65	9,300	740	550
17	5	5	.....	.....	.....	.....	.....	65	[b]45	6,300	[b]740	510
18	5	5	.....	.....	.....	.....	.....	[b]30	30	5,050	740	[b]470
19	5	5	.....	.....	.....	.....	.....	20	25	4,300	700	475
20	5	5	.....	.....	.....	.....	.....	[b]15	15	3,550	640	480
21	5	5	.....	.....	.....	.....	.....	10	10	3,150	[b]570	[b]490
22	5	5	.....	.....	.....	.....	.....	5	10	2,700	550	500
23	5	5	.....	.....	.....	.....	.....	5	40	2,460	570	480
24	5	5	.....	.....	.....	.....	.....	15	[b]80	2,250	[b]580	[b]490
25	5	5	.....	.....	.....	.....	.....	[b]90	50	2,460	620	480
26	5	5	.....	.....	.....	.....	.....	170	[b]50	2,040	660	470
27	10	5	.....	.....	.....	.....	.....	[b]285	110	1,800	650	475
28	15	5	.....	.....	.....	.....	.....	200	[b]280	1,620	640	[b]415
29	15	5	.....	.....	.....	.....	.....	200	500	1,620	630	475
30	15	.....	.....	.....	.....	.....	.....	[b]225	[b]620	1,620	[b]590	480
31	15	.....	.....	.....	.....	.....	.....	285	.....	1,500	.....	[b]430

[a] No flow. [b] Meter measurement.

Estimated monthly discharge of Rio Grande near El Paso, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	75	5	16	972
February	15	5	7	387
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	480	0	120	7,398
September	655	10	184	10,959
October	17,100	1,500	5,960	366,486
November	1,490	550	813	48,397
December	980	415	621	38,182
The year	17,100	0	643	472,781

RIO GRANDE ABOVE PRESIDIO, TEX.

This station was established April 4, 1900, by the International (Water) Boundary Commission. It is 7 miles above Presidio and above the mouth of Conchos River, one of the principal tributaries of the Rio Grande, and is about 200 miles below El Paso. Its location is far enough above the mouth of Conchos River to be free from the effects of backwater from that stream.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Rio Grande above Presidio, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
June 19	Jas. P. Hague	183	1.43	2.6	261
June 24	do	29	0.31	1.5	9
June 27	do	473	3.90	6.75	1,845
June 30	do	49	0.41	1.8	20
September 5	do	420	3.84	6.1	1,614
September 7	do	232	3.35	4.6	778
October 8	do	341	3.53	5.2	1,205
October 10	do	506	4.28	7.3	2,166
October 12	do	549	4.47	7.6	[a]2,454
October 14	do	603	5.01	7.65	[a]3,024
October 18	do	693	5.21	8.2	[a]3,610
October 20	do	632	5.27	8.0	[a]3,331
October 22	do	619	5.25	8.2	[a]3,251
October 25	do	500	4.71	7.5	2,357
October 26	do	487	4.60	7.3	2,242
October 28	do	452	4.45	7.0	2,012
November 1	do	411	3.82	6.1	1,570
November 3	do	382	3.87	5.9	1,478
November 6	do	335	3.76	5.7	1,258
November 9	do	269	3.21	4.9	864
November 11	do	257	3.19	4.6	821
November 14	do	251	2.80	4.3	704
November 16	do	241	2.79	4.2	672
November 18	do	203	3.16	4.0	641
November 21	do	196	3.10	3.9	607
November 23	do	187	2.91	3.8	545
November 26	do	172	2.96	3.6	509
November 29	do	160	2.77	3.5	443
December 2	do	164	2.59	3.5	424
December 5	do	191	2.72	3.7	520
December 7	do	191	2.84	3.8	543
December 9	do	174	2.65	3.6	461
December 12	do	172	2.70	3.6	464
December 15	do	149	2.53	3.5	377
December 18	do	171	2.65	3.6	453
December 21	do	207	2.98	3.9	616
December 24	do	190	2.35	3.8	446
December 27	do	184	2.16	3.8	398
December 29	do	180	2.14	3.8	386
December 31	do	176	2.10	3.75	369

[a] Measurement in channel only; bottom overflowed.

Mean daily gage height, in feet, of Rio Grande above Presidio, Tex., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.[a]	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1						(a)	(a)	(a)	(a)	(a)	6.15	3.5
2						(a)	(a)	(a)	(a)	(a)	6.0	3.5
3						(a)	(a)	(a)	(a)	(a)	5.9	3.5
4						(a)	(a)	(a)	2.25	(a)	5.45	3.8
5						(a)	(a)	(a)	3.75	(a)	7.85	3.75
6						(a)	(a)	(a)	7.25	(a)	6.0	3.8
7						(a)	(a)	(a)	6.2	2.7	5.2	3.8
8						(a)	(a)	(a)	4.9	5.45	5.1	3.7
9						(a)	(a)	(a)	4.15	6.4	4.95	3.65
10						(a)	(a)	(a)	3.5	7.15	4.8	3.6
11						(a)	(a)	(a)	2.95	7.55	4.65	3.6
12						(a)	(a)	(a)	2.55	7.65	4.5	3.6
13						(a)	(a)	(a)	2.2	7.7	4.4	3.6
14						(a)	(a)	(a)	2.2	7.65	4.3	3.6
15						(a)	(a)	(a)	2.4	7.6	4.3	3.5
16						(a)	(a)	(a)	1.5	7.9	4.2	3.5
17						(a)	(a)	(a)	.85	8.25	4.1	3.45
18						(a)	(a)	(a)	2.25	8.2	4.0	3.6
19						2.9	(a)	(a)	2.65	8.2	4.0	3.95
20						1.7	(a)	(a)	2.6	8.0	4.0	3.95
21						1.95	(a)	(a)	4.05	8.0	3.9	3.9
22						(a)	(a)	(a)	2.55	8.2	3.9	4.1
23						5.15	(a)	(a)	2.5	7.95	3.8	4.0
24						.75	1.7	(a)	2.05	7.65	3.8	3.95
25						(a)	.9	1.2	1.0	7.5	3.7	3.9
26						7.25	(a)	(a)	2.25	7.3	3.6	3.55
27						6.55	(a)	(a)	1.95	7.3	3.6	3.7
28						2.6	(a)	(a)	.5	7.0	3.6	3.75
29						2.5	(a)	(a)	(a)	6.65	3.5	3.8
30						1.75	(a)	(a)	(a)	7.65	3.5	3.8
31							(a)	(a)		7.3		3.75

[a] No flow.

Mean daily discharge, in second-feet, of Rio Grande above Presidio, Tex., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.[a]	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
1						(a)	(a)	(a)	(a)	(a)	[b]1,590	435
2						(a)	(a)	(a)	(a)	(a)	1,520	[b]425
3						(a)	(a)	(a)	(a)	(a)	[b]1,480	425
4						(a)	(a)	(a)	85	(a)	1,260	530
5						(a)	(a)	(a)	[b]525	(a)	2,780	[b]535
6						(a)	(a)	(a)	2,140	(a)	[b]1,530	550
7						(a)	(a)	(a)	[b]1,660	310	1,010	[b]545
8						(a)	(a)	(a)	930	[b]1,310	965	500
9						(a)	(a)	(a)	645	1,750	[b]890	[b]480
10						(a)	(a)	(a)	450	[b]2,090	850	465
11						(a)	(a)	(a)	285	2,600	[b]830	465
12						(a)	(a)	(a)	165	[b]3,540	780	[b]465
13						(a)	(a)	(a)	75	4,200	740	450
14						(a)	(a)	(a)	75	[b]4,000	[b]705	430
15						(a)	(a)	(a)	125	3,630	705	[b]375
16						(a)	(a)	(a)	10	6,180	[b]670	385
17						(a)	(a)	(a)	10	9,360	655	370
18						(a)	(a)	(a)	85	[b]8,910	[b]640	[b]456
19						[b]340	(a)	(a)	195	8,910	640	640
20						20	(a)	(a)	180	[b]7,000	640	640
21						40	(a)	(a)	615	7,000	[b]605	[b]615
22						(a)	(a)	(a)	165	[b]8,550	605	675
23						1,180	(a)	(a)	150	6,350	[b]545	585
24						[b]5	40	(a)	45	3,540	545	[b]520
25						(a)	10	20	10	[b]2,410	530	480
26						2,100	(a)	(a)	85	[b]2,240	[b]510	290
27						[b]1,760	(a)	(a)	35	2,240	500	[b]350
28						260	(a)	(a)	5	[b]2,010	490	365
29						230	(a)	(a)	(a)	1,800	[b]445	[b]385
30						[b]20	(a)	(a)	(a)	3,540	445	385
31						.....	(a)	(a)	.....	2,010	.....	[b]370

[a] No flow.

[b] Meter measurements.

Estimated monthly discharge of Rio Grande above Presidio, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January[a]	0	0	0	0
February[a]	0	0	0	0
March[a]	0	0	0	0
April[a]	0	0	0	0
May[a]	0	0	0	0
June	2,100	0	198	11,812
July	40	0	2	100
August	20	0	1	40
September	2,140	0	292	17,355
October	9,360	0	3,403	209,216
November	2,780	445	870	51,769
December	675	290	471	28,969
The year	9,360	0	436	319,261

[a] No flow.

RIO GRANDE BELOW PRESIDIO, TEX.

This station was established April 8, 1900, by the International (Water) Boundary Commission. It is 6 miles below Presidio; also below the mouth of Conchos River and about 215 miles below El Paso. It is at the western end of the canyon section of the Rio Grande. The discharge at this station, minus the discharge at the station above Presidio, Tex., gives the discharge of the Conchos, except at rare intervals, when some rain water enters the Rio Grande from the north.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Rio Grande below Presidio, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
January 19	Jas. P. Hague	185	0.89	4.5	165
January 22	do	185	.88	4.5	163
January 25	do	195	.89	4.5	174
January 28	do	181	.89	4.5	161
January 30	do	179	.86	4.5	154
February 2	do	165	.76	4.4	125
February 5	do	161	.75	4.4	120

Discharge measurements of Rio Grande below Presidio, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
February 8	Jas. P. Hague	156	0.75	4.4	117
February 11	do	155	.74	4.4	114
February 14	do	157	.74	4.4	116
February 18	do	152	.79	4.4	120
February 22	do	150	.84	4.4	126
February 26	do	138	.82	4.4	113
February 29	do	130	.82	4.4	106
March 2	do	130	.79	4.3	103
March 5	do	118	.73	4.3	86
March 8	do	111	.96	4.3	107
March 12	do	100	.83	4.2	83
March 16	do	99	.83	4.15	82
March 20	do	93	.78	4.1	73
March 23	do	94	.81	4.1	76
March 26	do	71	.72	3.9	51
March 28	do	70	.71	3.9	50
March 31	do	63	.70	3.85	44
April 3	do	76	.53	3.8	40
April 7	do	71	.55	3.8	39
April 10	do	65	.48	3.7	31
April 13	do	52	.38	3.6	20
April 16	do	52	.38	3.6	20
April 19	do	54	.35	3.6	19
April 22	do	47	.38	3.6	18
April 25	do	45	.31	3.5	14
April 29	do	44	.30	3.5	13
May 3	do	39	.15	3.4	6
May 7	do	34	.15	3.4	5
May 11	do	34	.15	3.4	5
May 14	do	23	.13	3.3	3
May 19	do	117	1.03	4.3	120
May 21	do	80	.80	4.0	64
May 25	do	242	.99	4.8	239
May 27	do	174	.79	4.5	138
May 30	do	116	1.03	4.3	120
June 1	do	164	.79	4.5	130
June 4	do	245	.98	4.8	241
June 7	do	168	.82	4.5	137
June 9	do	386	.39	5.6	152
June 11	do	499	1.03	7.05	512

Discharge measurements of Rio Grande below Presidio, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
June 14	Jas. P. Hague	268	1.16	6.3	311
June 16	do	236	1.18	6.1	278
June 18	do	147	1.24	5.85	182
June 20	do	800	2.12	7.85	1,696
June 23	do	851	2.23	8.1	1,900
June 26	do	1,755	2.70	11.1	4,737
June 29	do	287	1.34	6.5	385
July 2	do	339	1.30	6.5	441
July 6	do	159	1.38	5.4	220
July 8	do	184	1.30	5.5	239
July 10	do	189	1.30	5.5	245
July 13	do	351	1.62	6.3	567
July 16	do	938	1.64	8.7	1,537
July 19	do	938	1.68	8.7	1,573
July 22	do	563	1.63	7.4	917
July 25	do	557	1.62	7.35	903
July 28	do	540	1.62	7.3	875
July 31	do	659	1.74	7.6	1,149
August 3	do	467	1.76	7.0	821
August 6	do	460	1.76	7.0	808
August 9	do	295	1.49	6.15	439
August 12	do	210	1.51	5.8	317
August 15	do	298	1.47	6.2	438
August 18	do	288	1.42	6.15	409
August 21	do	629	1.59	7.5	1,003
August 24	do	969	2.22	8.95	2,156
August 27	do	832	1.94	8.1	1,614
August 30	do	622	1.60	7.5	997
September 3	do	593	1.57	7.3	933
September 6	do	2,179	4.56	11.95	9,936
November 2	do	1,623	3.28	9.0	5,319
November 5	do	1,592	3.10	8.9	4,936
November 7	do	1,340	2.25	8.4	3,016
November 10	do	1,346	2.28	8.35	3,070
November 12	do	1,262	2.06	7.9	2,602
November 15	do	1,145	2.02	7.7	2,316
November 17	do	1,141	1.98	7.65	2,260
November 20	do	1,120	1.58	7.4	1,765
November 22	do	1,072	1.63	7.3	1,745
November 25	do	1,092	1.59	7.3	1,740
November 28	do	1,061	1.52	7.2	1,615

Discharge measurements of Rio Grande below Presidio, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
December 1	Jas. P. Hague	1,045	1.57	7.1	1,637
December 3	do	1,033	1.51	7.1	1,558
December 6	do	1,008	3.27	8.1	3,301
December 8	do	966	3.10	7.9	2,995
December 10	do	964	3.21	8.0	3,099
December 13	do	972	3.16	7.95	3,068
December 16	do	930	3.19	7.9	2,963
December 19	do	876	2.90	7.55	2,542
December 22	do	855	2.81	7.45	2,399
December 26	do	847	1.70	7.05	1,441
December 28	do	854	1.74	7.1	1,484
December 30	do	825	1.65	7.0	1,364

Mean daily gage height, in feet, of Rio Grande below Presidio, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.4	4.3	3.85	3.5	4.65	6.5	7.45	7.35	9.7	9.2	7.1
2	4.6	4.4	4.3	3.85	3.5	5.35	6.45	7.25	7.25	9.25	9.0	7.1
3	4.6	4.4	4.3	3.8	3.45	5.15	6.25	7.05	7.15	8.6	8.7	7.1
4	4.6	4.4	4.3	3.8	3.4	4.9	6.2	7.0	7.6	8.65	8.4	7.65
5	4.6	4.4	4.3	3.8	3.4	4.8	5.9	7.0	7.45	8.75	8.75	8.35
6	4.6	4.4	4.3	3.8	3.4	4.55	5.5	7.0	12.05	8.55	8.6	8.15
7	4.6	4.4	4.3	3.8	3.4	4.45	5.4	6.8	18.35	8.8	8.45	8.05
8	4.6	4.4	4.25	3.8	3.4	6.6	5.55	6.4	16.3	9.65	8.3	7.95
9	4.6	4.4	4.2	3.8	3.4	7.9	5.45	6.1	20.8	9.75	8.2	7.9
10	4.6	4.4	4.2	3.7	3.4	10.2	5.45	6.0	24.0	9.5	8.3	8.0
11	4.6	4.4	4.2	3.7	3.4	6.8	5.3	5.95	26.35	10.0	8.15	8.0
12	4.5	4.4	4.2	3.6	3.4	6.65	5.35	5.8	23.35	11.1	7.95	8.0
13	4.5	4.4	4.2	3.6	3.4	6.85	5.9	5.8	18.05	12.2	7.9	7.95
14	4.5	4.4	4.15	3.6	3.4	6.45	5.95	6.15	14.2	12.3	7.85	7.9
15	4.5	4.4	4.15	3.6	3.9	6.4	8.05	6.15	12.75	12.6	7.75	7.9
16	4.5	4.4	4.15	3.6	4.3	6.15	9.0	6.2	12.05	12.75	7.7	7.9
17	4.5	4.4	4.15	3.6	4.15	5.95	8.7	6.15	11.0	12.65	7.65	7.8
18	4.5	4.4	4.15	3.6	3.9	5.85	7.65	6.55	11.2	12.4	7.55	7.7
19	4.5	4.4	4.15	3.6	4.65	8.1	9.0	6.9	11.75	12.0	7.45	7.55
20	4.5	4.4	4.1	3.6	4.3	9.1	7.4	7.5	12.0	11.45	7.4	7.6
21	4.5	4.4	4.1	3.6	4.0	6.4	7.55	7.65	11.0	11.05	7.4	7.5
22	4.5	4.4	4.1	3.6	4.0	6.25	7.45	7.7	9.95	10.6	7.3	7.45
23	4.5	4.4	4.05	3.6	4.1	7.4	7.7	7.65	10.3	10.35	7.3	7.4
24	4.5	4.4	3.95	3.5	5.5	6.6	7.35	8.95	9.95	9.85	7.3	7.35
25	4.5	4.4	3.9	3.5	5.0	6.6	7.35	9.0	9.65	9.45	7.3	7.2
26	4.5	4.4	3.9	3.5	4.8	11.3	7.3	8.7	9.45	9.25	7.3	7.05
27	4.5	4.4	3.9	3.5	4.55	10.05	7.3	8.25	9.4	9.05	7.2	7.1
28	4.5	4.4	3.9	3.5	4.55	7.85	7.3	7.95	9.6	9.5	7.2	7.1
29	4.5	4.4	3.9	3.5	4.5	6.75	7.4	7.85	9.4	9.8	7.1	7.1
30	4.5	.....	3.85	3.5	4.35	6.5	7.5	7.6	9.1	10.1	7.1	7.0
31	4.5	.....	3.85	.....	4.3	.....	7.6	7.5	.....	9.4	.....	7.0

Mean daily discharge, in second-feet, of Rio Grande below Presidio, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	210	130	105	45	10	a185	420	1,070	950	7,770	6,000	a1,640
2	210	a125	a105	45	10	445	a430	960	920	6,200	a5,320	1,600
3	210	125	95	a40	a10	370	390	a850	a890	3,920	4,270	a1,560
4	210	120	90	40	5	a280	380	820	1,170	4,100	3,220	2,520
5	210	a120	a85	40	5	240	320	815	1,050	4,450	a4,350	3,740
6	200	120	90	40	5	155	a240	a810	a10,340	3,750	3,780	a3,390
7	200	120	95	a40	a5	a120	220	720	15,600	4,630	a3,200	3,220
8	200	a115	a95	40	5	900	a250	545	30,600	7,600	2,950	a3,070
9	200	115	85	40	5	a150	230	a425	75,100	7,950	2,880	3,000
10	190	115	85	a30	5	330	a240	385	115,500	7,080	a3,010	a3,100
11	190	a115	85	30	a5	a445	220	365	149,200	8,830	2,860	3,100
12	170	115	a85	20	5	405	220	a315	106,700	12,680	a2,650	3,100
13	170	115	85	a20	5	460	a400	315	45,000	16,700	2,600	a3,070
14	170	a115	80	20	a5	a350	420	425	22,000	17,100	2,530	2,960
15	170	115	80	20	55	335	1,280	a425	18,900	18,300	a2,390	2,960
16	170	120	a80	a20	120	a285	a1,660	440	16,100	18,900	2,320	a2,960
17	165	120	80	20	95	220	1,560	420	12,320	18,500	a2,260	2,840
18	165	a120	80	20	55	a180	1,050	a585	13,040	17,500	2,060	2,720
19	a165	120	80	a20	a205	1,900	a1,720	785	15,020	15,900	1,860	a2,540
20	165	125	a75	20	120	a2,800	920	1,000	15,900	13,920	a1,770	2,610
21	165	125	75	20	a65	595	995	a1,100	12,320	12,480	1,770	2,470
22	a165	a125	75	a20	65	460	a945	1,140	8,650	10,900	a1,740	a2,400
23	165	125	a70	20	85	a1,340	1,080	1,100	9,870	10,020	1,740	2,280
24	170	120	55	15	470	745	905	a2,160	8,650	8,270	1,740	2,160
25	a175	115	50	a15	a290	745	a905	2,200	7,600	6,870	a1,740	1,800
26	170	a115	a50	15	240	a4,960	875	2,000	6,900	6,180	1,720	a1,440
27	165	110	50	15	a150	3,660	875	a1,710	6,720	5,490	1,640	1,480
28	a160	110	a50	15	150	1,575	a875	1,470	7,420	7,050	a1,620	a1,480
29	160	a105	50	a10	140	a585	970	1,360	6,720	8,100	1,540	1,480
30	a155	.....	45	10	a125	385	1,060	a1,100	5,670	9,150	1,540	a1,360
31	155	.....	a45	.....	120	.....	a1,150	1,000	.....	6,700	.....	1,360

a Meter measurements.

Estimated monthly discharge of Rio Grande below Presidio, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	210	155	179	10,998
February	130	105	118	6,813
March	105	45	76	4,671
April	45	10	25	1,517
May	470	5	85	5,227
June	4,960	120	853	50,787
July	1,720	220	749	46,026
August	2,200	315	928	57,055
September	149,200	890	24,894	1,481,296
October	18,900	3,750	9,903	608,906
November	6,000	1,540	2,636	156,833
December	3,740	1,360	2,433	149,574
The year	149,200	5	3,573	2,579,703

RIO GRANDE NEAR LANGTRY, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is located one-half mile south of Langtry station, on the Southern Pacific Railway, and is about 440 miles below El Paso, Tex., at the eastern end of the canyon section of the Rio Grande and a short distance to the west of the mouth of Pecos River, one of the principal tributaries of the Rio Grande.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Rio Grande near Langtry, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 5	J. D. Dillard	412	1.39	0.9	573
January 9	do	410	1.38	.9	567
January 14	do	408	1.38	.9	564
January 19	do	401	1.34	.85	538
January 25	do	393	1.31	.8	513
January 30	do	396	1.25	.8	495
February 4	do	388	1.26	.8	487
February 9	do	390	1.23	.8	478
February 14	do	392	1.23	.8	482
February 19	do	390	1.22	.8	477
February 24	do	384	1.21	.75	465
February 29	do	384	1.18	.75	453
March 5	do	374	1.13	.7	421
March 10	do	374	1.13	.7	424
March 15	do	367	1.11	.65	406
March 21	do	355	1.09	.6	386
March 26	do	353	1.06	.55	375
March 31	do	349	1.08	.55	377
April 5	do	344	.98	.5	388
April 9	do	344	.99	.5	339
April 15	do	563	2.47	1.8	1,390
April 20	do	332	.96	.5	318
April 25	do	324	.93	.45	300
April 30	do	327	.92	.45	302
May 5	do	327	.90	.45	294
May 9	do	318	.84	.4	268
May 14	do	341	.97	.5	332
May 18	do	328	.92	.45	302
May 23	do	780	3.34	2.6	2,606
May 27	do	912	3.67	3.1	3,344

Discharge measurements of Rio Grande near Langtry, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
May 31	J. D. Dillard	623	3.09	2.1	1,927
June 4	do	407	1.58	1.0	644
June 9	do	494	2.19	1.5	1,080
June 10	do	1,306	4.81	4.8	6,284
June 14	do	590	2.89	2.0	1,703
June 18	do	382	1.64	1.0	628
June 24	do	571	2.81	1.95	1,604
June 30	do	909	4.37	3.5	3,972
July 3	E. E. Winter	490	1.57	1.8	768
July 13	do	351	1.55	.9	543
July 15	do	366	1.62	1.0	594
July 19	do	441	1.68	1.4	740
July 24	do	501	1.96	1.8	981
July 29	do	472	1.86	1.6	880
August 2	do	465	1.55	1.3	722
August 8	do	504	1.60	1.4	808
August 12	do	439	1.61	1.2	706
August 16	do	407	1.48	1.0	602
August 22	do	392	1.64	1.1	642
August 26	do	508	1.93	1.6	980
August 29	do	662	2.80	2.4	1,852
September 2	do	561	2.42	2.0	1,358
September 8	do	2,483	9.12	9.4	22,657
November 2	do	1,614	5.87	5.0	9,467
November 6	do	1,347	4.33	4.1	5,835
November 10	do	1,156	3.67	3.5	4,245
November 15	do	919	3.54	2.7	3,253
November 17	do	834	3.49	2.6	2,907
November 21	do	870	3.25	2.3	2,827
November 25	do	921	2.35	2.2	2,166
November 29	do	817	2.33	1.9	1,904
December 4	do	754	2.17	1.7	1,638
December 8	do	1,062	3.61	3.0	3,836
December 12	do	797	3.06	2.5	2,435
December 16	do	797	2.92	2.6	2,329
December 20	do	962	2.86	2.7	2,755
December 28	do	590	2.11	1.8	1,247

Mean daily gage height, in feet, of Rio Grande near Langtry, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.8	0.75	0.55	0.45	1.5	1.55	1.3	2.15	5.65	5.2	1.75
2	.9	.8	.75	.55	.45	1.25	1.8	1.3	1.95	4.95	4.9	1.7
3	.9	.8	.75	.55	.45	1.1	1.75	1.3	1.85	4.9	4.7	1.7
4	.9	.8	.75	.55	.45	1.0	1.55	1.55	2.15	4.95	4.3	1.75
5	.9	.8	.75	.55	.45	.9	1.4	1.7	2.9	4.55	4.2	1.75
6	.9	.8	.7	.5	.45	2.45	1.3	1.7	5.6	4.0	4.05	2.45
7	.9	.8	.7	.5	.45	1.25	1.25	1.45	7.1	3.9	4.0	3.15
8	.9	.8	.7	.5	.4	.9	1.2	1.35	9.4	3.8	3.95	2.95
9	.9	.8	.7	.5	.4	1.35	1.3	1.3	6.7	3.8	3.85	2.8
10	.9	.8	.7	.5	.4	4.6	1.1	1.3	7.95	4.15	3.5	2.6
11	.9	.8	.7	.5	.4	3.5	1.1	1.3	16.95	5.4	3.4	2.6
12	.9	.8	.7	.5	.4	1.7	1.0	1.25	28.4	6.15	3.35	2.5
13	.9	.8	.7	.5	.4	1.9	.95	1.1	34.25	6.75	3.25	2.4
14	.9	.8	.7	.5	.5	2.05	.9	1.1	27.75	8.3	3.0	2.3
15	.9	.8	.65	1.7	.5	1.55	1.1	1.0	19.15	8.95	2.7	2.7
16	.9	.8	.65	.6	.5	1.25	1.0	1.0	11.7	8.25	2.6	2.65
17	.9	.8	.65	.6	.5	1.2	1.1	.95	11.45	8.9	2.55	2.65
18	.9	.8	.65	.6	.45	1.0	1.95	.85	12.6	9.0	2.5	2.7
19	.9	.8	.65	.5	.45	1.0	1.3	.8	11.95	10.3	2.5	2.7
20	.85	.8	.6	.5	.45	2.8	1.15	.8	11.9	8.55	2.45	2.65
21	.85	.8	.6	.5	.45	2.35	1.5	.8	10.7	8.1	2.25	2.6
22	.85	.8	.6	.5	.6	2.5	1.9	1.1	8.65	8.45	2.25	2.55
23	.85	.8	.55	.5	2.45	2.3	2.1	1.25	7.9	7.5	2.2	2.55
24	.8	.75	.55	.45	1.65	1.95	1.8	1.4	6.9	6.8	2.2	2.3
25	.8	.75	.55	.45	3.3	1.85	1.55	1.65	6.45	6.45	2.2	2.05
26	.8	.75	.55	.45	1.3	4.55	1.2	1.6	6.25	6.1	2.2	2.0
27	.8	.75	.55	.45	2.9	7.5	1.8	1.7	6.35	5.3	2.15	1.8
28	.8	.75	.55	.45	5.15	7.4	1.7	2.4	6.15	4.8	2.0	1.8
29	.8	.75	.55	.45	4.1	4.75	1.45	2.4	5.55	4.75	1.9	1.75
30	.8	.....	.55	.45	2.4	3.15	1.3	2.35	5.35	5.05	1.8	1.7
31	.8	.....	.55	.....	2.1	.....	1.2	2.3	.....	5.7	.....	1.7

Mean daily discharge, in second-feet, of Rio Grande near Langtry, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	590	490	450	375	300	1,200	705	720	1,540	11,350	10,000	1,710
2	585	490	450	375	300	910	770	a720	a1,300	9,250	a9,000	1,640
3	580	485	445	375	300	750	a755	720	1,180	9,100	8,200	1,640
4	575	a485	440	375	295	a640	705	940	1,540	9,250	6,600	a1,720
5	a575	485	a435	a375	a295	560	670	1,070	3,040	8,050	6,200	1,720
6	575	485	420	340	295	2,320	645	1,070	9,250	6,400	a5,660	2,900
7	570	480	420	340	295	870	630	850	13,150	6,100	5,500	4,090
8	565	480	420	340	270	560	620	a780	a22,660	5,800	5,350	a3,750
9	a565	a480	425	a340	a270	a950	645	750	12,110	5,800	5,080	3,280
10	565	480	a425	340	270	a5,940	595	750	14,950	6,850	a4,240	2,720
11	565	480	425	340	270	4,020	595	750	47,100	10,600	4,110	2,720
12	565	480	425	340	270	1,370	570	a730	99,900	12,850	4,050	a2,440
13	565	480	420	340	270	1,590	a560	650	132,000	14,650	3,920	2,240
14	a565	a480	420	340	a330	a1,750	545	650	96,600	19,300	3,610	2,320
15	565	480	a405	a1,290	330	1,190	a630	600	56,200	21,250	a3,250	2,540
16	565	480	405	380	330	860	595	a600	29,570	19,150	3,030	a2,410
17	565	480	400	380	330	810	640	580	28,820	21,100	a2,860	2,470
18	565	475	400	380	a300	a630	1,070	520	32,270	21,400	2,860	2,620
19	a565	a475	400	320	300	630	a700	500	30,320	25,300	2,910	2,690
20	540	475	385	a320	300	2,860	640	500	30,170	20,050	2,920	a2,680
21	540	475	a385	320	300	2,160	790	500	26,570	18,700	a2,780	2,600
22	540	475	385	320	390	2,390	1,040	a640	20,420	19,750	2,640	2,520
23	540	475	375	320	a2,400	2,090	1,160	740	18,170	16,900	2,450	2,180
24	515	a465	375	300	1,310	a1,600	a980	840	15,170	14,800	2,310	1,840
25	a515	465	375	a300	3,840	1,480	860	1,020	13,820	13,750	a2,170	1,670
26	515	460	a375	300	840	6,000	730	a980	13,220	12,700	2,170	1,590
27	510	460	375	300	a3,050	14,200	980	1,090	13,520	10,300	2,120	1,250
28	505	455	375	300	8,460	14,000	930	1,850	12,920	8,800	1,990	a1,250
29	500	a455	375	300	5,840	6,400	a820	a1,850	11,120	8,650	a1,900	1,180
30	a495	.....	375	300	2,350	a3,410	760	1,800	10,520	9,550	1,810	1,110
31	495	.....	a375	.....	a1,930	.....	720	1,750	.....	11,500	.....	1,110

a Meter measurements.

Estimated monthly discharge of Rio Grande near Langtry, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	590	495	550	33,798
February	490	455	476	27,392
March	450	375	405	24,912
April	1,290	300	369	21,947
May	8,460	270	1,182	72,654
June	14,200	560	2,805	166,889
July	1,160	545	744	45,729
August	1,850	500	887	54,565
September	132,000	1,180	27,304	1,624,700
October	25,300	5,800	13,194	811,239
November	10,000	1,810	4,056	241,369
December	4,090	1,110	2,213	136,066
The year	132,000	270	4,515	3,261,260

RIO GRANDE BELOW MOUTH OF DEVILS RIVER, TEXAS.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is alongside the Southern Pacific Railway track, about a half mile below the mouth of Devils River and about 480 miles below El Paso.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Rio Grande below mouth of Devils River, Texas, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
January 2	J. D. Dillard	1,128	1.55	3.65	1,753
January 7	do	1,115	1.50	3.6	1,678
January 12	do	1,115	1.47	3.6	1,638
January 18	do	1,089	1.46	3.55	1,592
January 23	do	1,069	1.44	3.5	1,537
January 28	do	1,066	1.43	3.5	1,528
February 2	do	1,093	1.41	3.5	1,542
February 6	do	1,078	1.39	3.5	1,494
February 11	do	1,063	1.37	3.5	1,453
February 16	do	1,090	1.37	3.5	1,492
February 22	do	1,096	1.37	3.5	1,503
February 27	do	1,100	1.38	3.5	1,515
March 3	do	1,065	1.31	3.4	1,392
March 8	do	1,071	1.32	3.45	1,418
March 13	do	1,060	1.30	3.4	1,376
March 18	do	1,058	1.28	3.4	1,358
March 24	do	1,057	1.26	3.4	1,331
March 29	do	1,044	1.22	3.35	1,276
April 4	do	1,054	1.26	3.4	1,330
April 8	do	1,043	1.22	3.35	1,277
April 13	do	1,031	1.18	3.3	1,217
April 18	do	1,031	1.20	3.3	1,241
April 23	do	1,050	1.28	3.4	1,339
April 28	do	1,031	1.16	3.25	1,193
May 3	do	1,039	1.19	3.35	1,235
May 7	do	1,048	1.22	3.4	1,277
May 12	do	999	1.12	3.25	1,116
May 17	do	1,046	1.25	3.4	1,308
May 21	do	1,019	1.17	3.3	1,189
May 24	do	1,342	2.15	4.4	2,885
May 28	do	1,484	2.62	4.8	3,893
June 2	do	1,192	2.00	4.05	2,389
June 7	do	1,885	4.19	6.2	7,899
June 12	do	1,501	3.19	5.0	4,792

Discharge measurements of Rio Grande below mouth of Devils River, Texas, in 1904—Con.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
June 16	J. D. Dillard	1,208	2.06	4.1	2,489
June 21	do	1,112	1.62	3.7	1,798
June 28	do	4,402	7.47	13.0	32,871
July 6	E. E. Winter	1,433	2.12	4.2	3,031
July 12	do	1,231	1.74	3.7	2,147
July 15	do	1,196	1.62	3.6	1,939
July 22	do	1,333	1.93	4.2	2,579
July 26	do	1,295	1.90	4.0	2,461
July 30	do	1,245	1.77	3.9	2,209
August 4	do	1,210	1.52	3.7	1,845
August 8	do	1,263	1.74	3.9	2,203
August 13	do	1,222	1.55	3.7	1,894
August 17	do	1,028	1.53	3.6	1,577
August 23	do	1,010	1.51	3.6	1,527
August 26	do	1,126	1.66	4.0	1,869
August 30	do	1,308	2.02	4.4	2,638
September 6	do	1,739	3.91	5.7	6,795
September 10	do	2,739	5.78	8.3	15,842
September 13	do	11,651	9.93	24.3	115,750
September 19	do	3,795	7.27	10.5	27,578
September 24	do	3,399	6.47	9.0.	21,986
September 27	do	2,686	6.31	7.5	16,957
October 3	do	2,565	6.10	7.4	15,657
October 7	do	2,437	5.96	7.3	14,523
October 13	do	2,227	6.08	7.4	13,539
October 18	do	3,604	7.12	10.5	25,676
October 25	do	2,599	6.28	10.2	16,323
November 5	do	2,612	3.18	6.9	8,307
November 9	do	2,650	2.77	6.7	7,333
November 13	do	1,838	2.84	5.8	5,225
November 16	do	1,597	2.61	5.4	4,171
November 19	do	1,479	2.47	5.0	3,649
November 23	do	1,486	2.30	4.7	3,423
November 28	do	1,426	2.13	4.5	3,034
December 3	do	1,503	1.95	4.5	2,935
December 7	do	1,779	2.46	5.7	4,370
December 10	do	1,613	2.41	5.3	3,886
December 15	do	1,686	2.21	5.1	3,733
December 19	do	1,723	2.49	5.3	4,284
December 23	do	1,653	2.23	4.7	3,694
December 31	do	1,270	2.22	4.3	2,814

Mean daily gage height, in feet, of Rio Grande, below mouth of Devils River, Texas, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.65	3.5	3.5	3.4	3.3	4.3	5.15	3.75	4.25	7.65	8.8	4.5
2	3.65	3.5	3.5	3.4	3.3	4.0	4.7	3.7	4.2	7.25	8.1	4.5
3	3.6	3.5	3.5	3.4	3.4	3.8	4.45	3.7	4.0	7.2	7.45	4.5
4	3.6	3.5	3.45	3.4	3.4	3.65	4.4	3.7	4.3	6.9	7.15	4.5
5	3.6	3.5	3.45	3.4	3.55	4.5	4.25	3.8	4.3	6.5	6.7	4.65
6	3.6	3.5	3.4	3.35	3.5	4.35	4.15	3.9	5.7	6.65	6.35	5.05
7	3.6	3.5	3.4	3.35	3.4	5.95	4.1	3.7	6.5	6.95	7.0	5.0
8	3.6	3.5	3.4	3.35	3.3	5.15	4.05	3.9	8.4	6.3	6.8	5.5
9	3.6	3.5	3.4	3.3	3.3	4.15	4.0	3.9	9.15	6.15	6.6	5.55
10	3.6	3.5	3.4	3.3	3.3	5.0	3.85	3.8	8.45	6.3	6.2	5.3
11	3.6	3.5	3.45	3.3	3.3	5.35	3.8	3.75	10.2	7.2	5.95	5.15
12	3.6	3.5	3.45	3.3	3.25	5.2	3.7	3.7	16.0	7.5	5.8	5.0
13	3.6	3.5	3.4	3.3	3.3	4.55	3.7	3.7	22.75	7.7	5.8	4.95
14	3.6	3.5	3.4	3.3	3.45	4.55	3.6	3.6	26.75	9.35	5.7	4.95
15	3.6	3.5	3.4	3.3	3.55	4.3	3.6	3.6	23.55	11.3	5.45	5.0
16	3.6	3.5	3.4	3.75	3.4	4.05	3.65	3.6	14.6	10.3	5.35	5.1
17	3.55	3.5	3.4	3.35	3.4	3.85	3.65	3.6	10.5	10.55	5.15	5.25
18	3.55	3.5	3.4	3.3	3.4	3.75	3.75	3.6	11.15	10.45	5.05	5.25
19	3.55	3.5	3.4	3.3	3.4	3.7	4.05	3.6	10.1	11.45	4.95	5.25
20	3.55	3.5	3.4	3.3	3.4	3.7	3.85	3.6	10.8	11.1	4.9	5.05
21	3.55	3.5	3.4	3.3	3.3	3.8	3.9	3.6	12.65	10.25	4.85	4.85
22	3.55	3.5	3.4	4.1	3.3	4.65	4.2	3.95	12.55	10.5	4.75	4.8
23	3.5	3.5	3.4	3.4	3.9	4.45	4.35	4.0	10.35	10.4	4.65	4.7
24	3.5	3.5	3.4	3.35	4.35	4.35	4.45	3.6	9.0	10.25	4.6	4.55
25	3.5	3.5	3.4	3.3	4.15	4.15	4.25	3.8	8.35	10.2	4.6	4.45
26	3.5	3.5	3.4	3.3	4.45	3.85	4.1	4.25	8.0	10.1	4.55	4.35
27	3.5	3.5	3.35	3.3	4.9	8.85	3.9	4.3	7.5	10.05	4.5	4.3
28	3.5	3.5	3.35	3.3	4.7	11.35	4.0	4.4	7.5	9.75	4.5	4.3
29	3.5	3.5	3.35	3.3	7.15	7.35	4.0	4.4	7.35	9.55	4.5	4.3
30	3.5	.....	3.35	3.3	5.35	5.5	3.9	4.35	7.3	9.5	4.5	4.3
31	3.5	.....	3.35	.....	4.5	.....	3.8	4.3	.....	9.4	.....	4.25

Mean daily discharge, in second-feet, of Rio Grande below mouth of Devils River, Texas, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,720	1,540	1,490	1,330	1,220	3,020	5,150	1,990	2,350	17,000	12,680	3,000
2	a1,750	a1,540	1,480	1,330	1,220	a2,300	4,110	1,890	2,250	15,510	11,070	2,970
3	1,700	1,530	a1,470	1,330	a1,280	1,970	3,560	1,870	1,870	a15,060	9,570	a2,940
4	1,690	1,520	1,430	a1,330	1,280	1,730	3,450	a1,850	2,450	13,960	8,880	2,940
5	1,690	1,510	1,430	1,330	1,460	3,540	3,140	2,020	2,450	12,560	a7,850	3,120
6	1,680	a1,500	1,390	1,280	1,400	3,160	a2,940	2,200	a6,800	12,810	6,910	3,600
7	a1,680	1,490	1,390	1,280	a1,280	a7,250	2,850	1,850	9,440	a13,610	8,280	a4,250
8	1,680	1,480	a1,380	a1,280	1,180	5,180	2,760	a2,200	16,240	11,300	7,690	4,130
9	1,670	1,470	1,380	1,220	1,180	2,620	2,670	2,200	19,900	10,640	a7,100	4,190
10	1,660	1,460	1,380	1,220	1,170	4,790	2,410	2,040	a16,440	10,880	6,160	a3,890
11	1,650	a1,450	1,420	1,220	1,170	5,700	2,320	1,970	26,460	13,370	5,580	3,750
12	a1,640	1,460	1,420	1,220	a1,120	a5,310	a2,150	1,890	54,100	14,060	5,230	3,610
13	1,640	1,470	a1,380	a1,220	1,190	3,640	2,150	a1,890	a102,300	a14,440	a5,230	3,550
14	1,630	1,480	1,380	1,220	1,370	3,640	1,940	1,670	138,800	20,360	4,960	3,550
15	1,630	1,490	1,370	1,220	1,490	3,000	a1,940	1,640	109,100	28,880	4,300	a3,610
16	1,620	a1,490	1,370	1,900	1,310	a2,100	1,990	1,610	46,300	24,880	a4,100	3,730
17	1,590	1,490	1,360	1,300	a1,310	2,050	1,990	a1,580	27,600	25,880	3,840	4,140
18	a1,590	1,490	a1,360	a1,240	1,310	1,880	2,100	1,580	30,200	a25,480	3,710	4,200
19	1,590	1,500	1,360	1,240	1,310	1,800	2,420	1,570	a25,980	29,500	a3,610	a4,230
20	1,580	1,500	1,350	1,240	1,310	1,800	2,210	1,560	28,740	26,740	3,570	4,030
21	1,580	1,500	1,350	1,240	a1,190	a1,970	2,260	1,550	36,610	21,980	3,530	3,830
22	1,570	a1,500	1,340	2,420	1,190	3,900	a2,580	1,840	36,180	21,620	3,460	3,780
23	a1,540	1,500	1,340	a1,310	2,000	3,390	2,910	a1,870	27,000	19,860	a3,320	a3,690
24	1,540	1,510	a1,330	1,290	a2,800	3,130	3,130	1,530	a21,990	17,900	3,230	3,360
25	1,540	1,510	1,330	1,240	2,490	2,620	2,630	1,700	19,800	a16,320	3,230	3,140
26	1,530	1,510	1,330	1,240	3,000	2,060	a2,520	a2,350	18,630	16,020	3,130	2,920
27	1,530	a1,510	1,290	1,240	4,140	15,070	2,210	2,450	a16,960	15,870	3,040	2,810
28	a1,530	1,520	1,280	a1,240	a3,640	a27,500	2,460	2,640	16,960	14,970	a3,030	2,810
29	1,530	1,520	a1,280	1,240	10,900	11,000	2,160	2,640	16,510	14,370	3,030	2,810
30	1,530	.....	1,270	1,240	5,280	6,090	a2,210	a2,540	16,360	14,220	3,030	2,810
31	1,530	.....	1,270	.....	3,130	.....	2,100	2,450	.....	13,920	.....	a2,700

a Meter measurements.

Estimated monthly discharge of Rio Grande below mouth of Devils River, Texas, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,750	1,530	1,614	99,233
February	1,540	1,450	1,498	86,162
March	1,490	1,270	1,368	84,089
April	2,420	1,220	1,323	78,704
May	10,900	1,120	2,107	129,560
June	27,500	1,730	4,784	284,648
July	5,150	1,940	2,636	162,089
August	2,640	1,530	1,956	120,258
September	138,800	1,870	29,893	1,778,777
October	29,500	10,640	17,544	1,078,750
November	12,680	3,030	5,412	322,016
December	4,250	2,700	3,487	214,393
The year	138,800	1,120	6,135	4,438,689

RIO GRANDE NEAR EAGLE PASS, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is a half mile above the highway bridge between Eagle Pass and Ciudad Porfirio Diaz, Mexico, and about 540 miles below El Paso, Tex.

The observations at this station during 1904 have been made under the direction of the International (Water) Boundary Commission.

Discharge measurements of Rio Grande near Eagle Pass, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
January 4	J. K. Wilson	1,436	1.50	2.0	2,147
January 7	do	1,393	1.46	1.9	2,027
January 11	do	1,380	1.43	1.9	1,973
January 14	do	1,387	1.51	1.9	2,088
January 18	do	1,390	1.48	1.9	2,061
January 21	do	1,384	1.42	1.9	1,963
January 25	do	1,361	1.41	1.8	1,914
January 28	do	1,346	1.42	1.8	1,907
January 31	do	1,347	1.40	1.8	1,882
February 3	do	1,321	1.38	1.8	1,821
February 7	do	1,323	1.39	1.8	1,834
February 10	do	1,348	1.39	1.8	1,875

Discharge measurements of Rio Grande near Eagle Pass, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
February 14	J. K. Wilson	1,321	1.41	1.8	1,862
February 17	do	1,323	1.39	1.8	1,844
February 20	do	1,311	1.41	1.8	1,843
February 23	do	1,306	1.40	1.8	1,824
February 26	do	1,306	1.42	1.8	1,854
February 29	do	1,305	1.41	1.8	1,836
March 3	do	1,279	1.35	1.8	1,731
March 7	do	1,281	1.36	1.8	1,738
March 10	do	1,274	1.33	1.8	1,700
March 14	do	1,256	1.32	1.7	1,660
March 25	do	1,235	1.32	1.6	1,633
March 28	do	1,243	1.31	1.6	1,625
March 31	do	1,224	1.32	1.6	1,618
April 4	do	1,425	1.46	1.95	2,074
April 7	do	1,367	1.40	1.8	1,916
April 11	do	1,254	1.28	1.6	1,604
April 14	do	1,229	1.27	1.6	1,555
April 18	do	1,243	1.25	1.6	1,553
April 20	do	1,175	1.17	1.5	1,378
April 23	do	1,211	1.24	1.6	1,498
April 27	do	1,151	1.16	1.5	1,340
April 30	do	1,133	1.13	1.4	1,282
May 3	do	1,146	1.12	1.4	1,283
May 7	do	1,321	1.36	1.7	1,798
May 10	do	1,162	1.14	1.4	1,323
May 13	do	1,124	1.11	1.3	1,248
May 17	do	1,281	1.32	1.6	1,691
May 21	do	1,075	1.21	1.4	1,303
May 25	do	1,551	1.71	2.5	2,651
June 2	do	1,499	2.33	2.7	3,496
June 5	do	1,475	1.60	1.9	2,365
June 8	do	2,093	3.65	4.05	7,643
June 11	do	1,587	2.25	2.8	3,577
June 14	do	1,669	2.23	2.95	3,723
June 17	do	1,576	2.04	2.4	3,220
June 19	do	1,364	1.67	2.0	2,277
June 23	do	1,812	2.44	3.0	4,427
June 25	do	1,559	2.09	2.6	3,260
June 28	do	3,764	8.27	7.4	31,122
June 29	do	5,128	6.81	8.75	34,928
July 3	do	2,275	2.44	2.9	5,555

Discharge measurements of Rio Grande near Eagle Pass, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet*
July 7	J. K. Wilson	2,111	1.33	2.15	2,809
July 11	do	1,866	1.20	1.9	2,258
July 14	do	1,791	1.07	1.6	1,923
July 18	do	1,714	1.07	1.5	1,842
July 21	do	1,827	1.17	1.9	2,139
July 25	do	2,606	2.34	3.75	6,109
July 27	do	1,916	1.25	2.1	2,397
July 30	do	1,892	1.24	2.1	2,348
August 3	do	1,719	1.09	1.8	1,896
August 6	do	1,726	1.09	1.8	1,883
August 9	do	1,775	1.15	2.0	2,035
August 13	do	1,705	1.01	1.5	1,726
August 17	do	1,677	0.99	1.5	1,658
August 20	do	1,666	1.05	1.7	1,755
August 23	do	1,690	0.98	1.4	1,664
August 26	do	1,816	1.08	1.9	1,961
August 29	do	1,923	1.01	2.0	1,948
August 31	do	1,925	1.17	2.4	2,249
September 3	do	2,017	1.35	2.1	2,715
September 7	do	4,458	3.26	6.4	14,534
September 9	do	5,237	7.23	7.95	37,852
September 14 [a]	do	11,924	8.95	19.0	106,697
September 16 [a]	do	17,063	9.00	22.0	153,568
September 18 [a]	do	6,992	4.58	10.2	32,050
September 20	do	6,258	4.75	8.85	29,753
September 23	do	7,387	5.33	11.1	39,349
September 26	do	5,090	3.74	6.2	19,025
September 28	do	5,055	3.86	6.6	19,529
September 30	do	4,544	3.06	6.2	13,900
October 4	do	4,327	2.45	5.75	10,596
October 7	do	3,968	2.22	5.2	8,802
October 11	do	4,059	2.32	5.3	9,403
October 15	do	5,886	5.51	9.0	32,435
October 20	do	6,012	5.23	9.2	31,417
October 22	do	5,392	4.89	8.4	26,383
October 25	do	5,353	4.84	8.1	25,912
October 28	do	4,555	3.74	6.5	17,035
October 31	do	4,250	3.68	6.2	15,628
November 4	do	3,758	3.33	5.65	12,510
November 8	do	3,520	3.14	5.35	11,047

[a] Float measurement.

Discharge measurements of Rio Grande near Eagle Pass, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
November 11	J. K. Wilson	3,408	3.09	4.9	10,521
November 14	do	3,170	2.57	4.6	8,136
November 17	do	2,973	2.47	4.3	7,357
November 20	do	2,830	2.38	4.1	6,729
November 23	do	2,941	1.90	3.9	5,580
November 26	do	2,822	1.70	3.8	4,785
November 30	do	2,756	1.62	3.6	4,467
December 4	do	2,676	1.62	3.6	4,338
December 8	do	3,255	2.52	4.45	8.207
December 12	do	2,949	2.01	4.05	5,929
December 16	do	2,979	1.74	3.8	5,191
December 19	do	2,941	1.91	4.0	5,620
December 22	do	2,789	1.89	3.9	5,268
December 24	do	2,778	1.79	3.8	4,960
December 28	do	2,695	1.69	3.4	4,553
December 31	do	2,644	1.61	3.3	4,256

Mean daily gage height, in feet, of Rio Grande near Eagle Pass, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	1.8	1.8	1.6	1.4	2.7	3.9	1.85	2.4	6.55	6.3	3.6
2	2.0	1.8	1.8	1.75	1.4	2.7	3.2	1.8	2.25	6.35	6.4	3.6
3	2.0	1.8	1.8	1.9	1.4	2.2	2.8	1.75	2.1	5.95	6.4	3.6
4	2.0	1.8	1.8	1.95	1.4	2.0	2.5	1.65	2.5	5.7	5.7	3.6
5	1.9	1.8	1.8	1.8	1.4	1.9	2.5	1.7	2.45	5.95	5.5	3.6
6	1.9	1.8	1.8	1.8	1.4	2.75	2.35	1.85	2.35	5.35	5.35	3.6
7	1.9	1.8	1.8	1.8	1.7	2.7	2.15	2.0	7.1	5.15	5.7	4.35
8	1.9	1.8	1.8	1.7	1.5	3.85	2.0	2.2	6.65	5.1	5.4	4.45
9	1.9	1.8	1.8	1.7	1.45	3.45	2.0	1.95	8.0	5.2	5.3	4.4
10	1.9	1.8	1.8	1.6	1.4	2.4	2.1	2.0	7.0	5.2	5.05	4.4
11	1.9	1.8	1.75	1.6	1.35	3.5	1.9	1.75	6.85	5.45	4.85	4.25
12	1.9	1.8	1.7	1.6	1.3	3.65	1.8	1.5	9.3	6.1	4.7	4.1
13	1.9	1.8	1.7	1.6	1.3	3.45	1.65	1.65	12.1	6.35	4.65	3.9
14	1.9	1.8	1.7	1.6	1.4	2.75	1.6	1.5	18.15	7.25	4.55	3.9
15	1.9	1.8	1.7	1.6	1.5	2.9	1.6	1.5	23.1	8.8	4.4	3.8
16	1.9	1.8	1.7	1.5	1.6	2.55	1.6	1.45	22.6	8.6	4.45	3.8
17	1.9	1.8	1.7	1.65	1.6	2.3	1.55	1.45	13.75	8.5	4.3	4.0
18	1.9	1.8	1.65	1.55	1.55	2.15	1.5	1.4	10.0	8.55	4.3	4.0
19	1.9	1.8	1.6	1.5	1.5	2.0	1.5	1.35	9.05	8.75	4.2	4.05
20	1.9	1.8	1.6	1.5	1.4	1.85	1.7	1.5	8.75	9.2	4.1	4.0
21	1.9	1.8	1.6	1.4	1.4	1.7	1.9	1.4	9.2	8.7	4.0	3.95
22	1.9	1.8	1.6	1.4	1.4	2.25	1.85	1.4	10.7	8.45	3.9	3.9
23	1.9	1.8	1.6	1.9	1.4	2.95	2.2	1.6	10.55	8.5	3.85	3.9
24	1.8	1.8	1.6	1.55	1.4	2.75	4.1	1.55	8.5	7.95	3.8	3.8
25	1.8	1.8	1.6	1.5	2.45	2.55	3.4	1.55	6.85	8.05	3.8	3.7
26	1.8	1.8	1.6	1.5	2.25	2.3	2.35	1.6	6.1	7.35	3.8	3.6
27	1.8	1.8	1.6	1.45	2.6	2.1	2.1	1.7	6.95	6.9	3.7	3.45
28	1.8	1.8	1.6	1.4	3.4	7.3	1.85	1.95	6.6	6.45	3.7	3.4
29	1.8	1.8	1.6	1.4	3.75	8.5	2.15	2.1	6.45	6.1	3.65	3.4
30	1.8	.....	1.6	1.4	4.7	5.15	2.05	2.3	6.15	5.85	3.6	3.4
31	1.8	.....	1.6	.....	3.3	.....	1.9	2.4	.....	6.1	.....	3.3

Mean daily discharge, in second-feet, of Rio Grande near Eagle Pass, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,080	1,860	1,800	1,620	1,280	3,500	8,860	1,950	2,480	15,400	16,100	4,430
2	2,100	1,840	1,770	1,810	1,280	a3,500	6,550	1,870	2,600	14,640	16,570	4,400
3	2,120	a1,820	a1,730	2,000	a1,280	2,780	a5,190	a1,830	a2,720	11,880	16,570	4,370
4	a2,140	1,820	1,730	a2,070	1,280	2,500	4,080	1,750	3,720	a10,430	a12,770	a4,340
5	2,040	1,830	1,730	1,920	1,280	a2,360	4,080	1,790	3,600	11,600	11,800	4,340
6	2,030	1,830	1,740	1,920	1,280	4,440	3,530	a1,920	3,350	9,280	11,060	4,340
7	a2,030	a1,830	a1,740	a1,920	a1,800	4,320	a2,810	2,040	a17,330	a8,640	12,770	7,640
8	2,020	1,840	1,720	1,760	1,480	a6,990	2,470	2,200	15,530	8,470	a11,300	a8,210
9	2,010	1,860	1,710	1,760	1,400	5,690	2,470	a2,000	a38,050	8,800	10,990	7,920
10	1,990	a1,870	a1,700	1,600	a1,320	3,040	2,700	2,040	18,100	8,800	10,700	7,920
11	a1,970	1,870	1,680	a1,600	1,280	a5,850	a2,240	1,890	17,200	a10,000	a10,320	7,070
12	2,010	1,870	1,660	1,590	1,250	6,300	2,130	1,730	46,000	13,900	9,420	a6,210
13	2,050	1,860	1,660	1,570	a1,250	5,600	1,970	a1,830	62,800	15,400	8,780	5,480
14	a2,090	a1,860	a1,660	a1,560	1,390	a3,540	a1,920	1,710	a100,700	20,800	a7,960	5,480
15	2,080	1,860	1,660	1,560	1,540	3,680	1,920	1,690	172,300	a31,060	7,570	5,190
16	2,070	1,850	1,660	1,400	1,690	3,360	1,920	1,650	a168,800	29,600	7,700	a5,190
17	2,060	a1,840	1,660	1,630	a1,690	a2,990	1,880	a1,640	60,500	28,560	a7,360	5,620
18	a2,060	1,840	1,650	a1,460	1,590	2,630	a1,840	1,620	a31,720	28,420	7,360	5,620
19	2,020	1,840	1,640	1,380	1,500	a2,280	1,840	1,600	30,110	29,170	7,050	a5,770
20	1,990	a1,840	1,640	a1,380	1,300	2,040	1,980	a1,690	a29,580	a31,420	a6,730	5,620
21	a1,960	1,840	1,640	1,280	a1,300	1,800	a2,130	1,660	31,220	28,420	6,250	5,440
22	1,960	1,840	1,630	1,280	1,300	2,780	2,090	1,660	37,550	a26,580	5,770	a5,270
23	1,960	a1,830	1,630	a1,980	1,300	a4,300	2,730	a1,800	a36,920	26,780	a5,440	5,270
24	1,910	1,830	1,630	1,420	1,300	3,690	6,940	1,770	28,450	25,090	5,120	a4,960
25	a1,910	1,840	a1,630	1,350	a2,570	a3,120	a5,260	1,770	21,680	a25,640	4,960	4,850
26	1,910	a1,850	1,630	1,340	2,300	2,990	2,910	a1,800	a18,520	21,720	a4,790	4,750
27	1,910	1,850	1,630	a1,310	2,900	2,810	a2,390	1,830	22,000	19,240	4,630	4,600
28	a1,910	1,840	a1,630	1,280	4,900	a30,600	2,070	1,950	a19,520	a16,800	4,630	a4,550
29	1,900	a1,840	1,620	1,280	6,220	a34,180	2,410	a2,020	16,950	15,160	4,550	4,520
30	1,890	.....	1,620	a1,280	10,300	12,980	a2,280	2,170	a13,650	13,980	a4,470	4,490
31	a1,880	.....	a1,620	.....	4,640	.....	2,130	a2,250	.....	a15,160	.....	a4,260

a Meter measurements.

Estimated monthly discharge of Rio Grande near Eagle Pass, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
January	2,140	1,880	2,002	123,094
February	1,870	1,820	1,844	106,086
March	1,800	1,620	1,673	102,843
April	2,070	1,280	1,577	93,838
May	10,300	1,250	2,167	133,269
June	34,180	1,800	5,886	350,261
July	8,860	1,840	3,088	189,858
August	2,250	1,600	1,843	113,296
September	172,300	2,480	35,622	2,119,636
October	31,420	8,470	18,735	1,151,960
November	16,570	4,470	8,716	518,658
December	8,210	4,260	5,423	333,461
The year	172,300	1,250	7,381	5,336,270

CONEJOS RIVER NEAR MOGOTE, COLO.

This station was established August 25, 1899, by A. L. Fellows. The gage is located 500 feet below the highway bridge 4 miles above Mogote, Colo. The gage is an inclined pine timber, 2 by 6 inches, painted white and graduated in vertical feet and tenths with black paint and brass tacks. It is securely spiked to the stump of a dead tree on the right bank. It is read twice each day by Miss Nellie King. Discharge measurements are made from the downstream side of the highway bridge. The initial point for soundings is the inside face of the abutment on the right bank, downstream side. The channel is straight above and below the station, and the banks, though low, are not liable to overflow. The bed of the stream is composed of gravel and cobblestones. There is but one channel, broken by the central pier of the two-span bridge.

There is one bench mark at this station. It is composed of three 20-penny nails driven into the root of a large cottonwood about 300 feet south of the gage and 7.87 feet above its zero.

Discharge measurements of Conejos River near Mogote, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
May 3	G. B. Monk	85	170	1.79	2.22	305
June 8	do	88	179	2.31	2.40	412
June 17	do	88	179	2.37	2.45	424
June 27	do	87	144	1.31	1.95	188
July 21[a]	do	63	74	.53	1.45	39
July 29	do	89	124	.81	1.85	101
August 25	do	85	143	1.11	1.90	159

[a] Measured at different section.

Mean daily gage height, in feet, of Conejos River near Mogote, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.60	2.50	2.55	1.90	2.45	2.55	3.60
2	1.75	2.35	2.45	1.90	2.35	2.45	3.00
3	1.60	2.15	2.35	1.80	2.35	2.35	2.75
4	1.60	2.10	2.15	1.80	2.60	2.30	2.60
5	1.55	2.10	2.10	1.70	2.75	2.20	2.50
6	1.65	2.15	2.10	1.65	2.25	2.20	2.40
7	1.55	2.20	2.20	1.55	2.35	2.10	3.00
8	1.60	2.35	2.45	1.55	2.45	2.00	3.00
9	1.60	2.35	2.50	1.50	2.25	2.00	3.25
10	1.55	2.45	2.30	1.50	2.10	1.90	3.05
11	1.80	2.60	2.30	1.50	2.10	1.90	2.95
12	1.85	2.65	2.45	1.50	2.00	1.80	2.85
13	2.20	2.80	2.30	1.45	2.00	1.80	2.75
14	2.40	2.80	2.35	1.40	2.15	1.70	2.65
15	2.50	2.50	2.30	1.40	2.20	1.70	2.55
16	2.40	2.55	2.40	1.40	2.20	1.70	2.55
17	2.50	2.55	2.45	1.40	2.10	1.70	2.50
18	2.50	2.75	2.30	1.30	2.10	1.65	2.45
19	2.50	2.85	2.20	1.40	2.25	1.60	2.30
20	2.45	2.80	2.15	1.40	2.20	1.60	2.20
21	2.45	2.80	2.10	1.50	2.10	1.60	2.20
22	2.10	2.65	2.25	1.50	2.00	1.60	2.15
23	2.15	2.80	2.00	1.50	2.00	1.65	2.10
24	2.00	2.80	2.10	1.60	2.05	1.80	2.10
25	2.15	2.55	1.90	1.70	2.00	1.80	2.10
26	2.50	2.50	1.95	1.60	2.05	1.80	2.10
27	2.55	2.55	2.00	1.65	2.05	1.70	1.95
28	2.75	2.50	2.05	1.80	2.00	1.80	1.90
29	2.55	2.50	1.90	2.10	2.00	2.02	1.90
30	2.45	2.55	1.85	2.10	2.45	4.00	1.90
31		2.50		1.95	2.50		1.80

Rating table for Conejos River near Mogote, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	10	1.90	160	2.50	480	3.20	1,045
1.40	20	2.00	205	2.60	550	3.30	1,135
1.50	40	2.10	255	2.70	620	3.40	1,235
1.60	60	2.20	305	2.80	700	3.50	1,335
1.70	90	2.30	360	2.90	780	3.60	1,435
1.80	120	2.40	420	3.00	865	3.70	1,545

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 1.50 feet and 2.50 feet. The table has been extended beyond these limits. Above gage height 3.75 feet the rating curve is a tangent, the difference being 120 per tenth.

Estimated monthly discharge of Conejos River near Mogote, Colo., for 1904.

[Drainage area, 282 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	660	50	283	16,840	1.00	1.12
May	740	255	509	31,300	1.80	2.08
June	515	140	320	19,040	1.13	1.26
July	255	10	76.1	4,679	.270	.311
August	660	205	316	19,430	1.12	1.29
September	1,900	60	233	13,860	.826	.922
October	1,435	120	515	31,670	1.83	2.11

PECOS RIVER AT SANTA ROSA, N. MEX.

This station was established May 5, 1903, by H. C. Hurd. It was originally located at the bridge of the Chicago, Rock Island and Pacific Railway. The gage rod is a 2 by 4 inch timber, graduated to feet and tenths. It is bolted to the masonry footing of the east tower. Daily readings are made by L. M. Shely, a bank clerk. The initial point for soundings was the end of the girder at the east end of the bridge. Both banks are high and can not overflow. The bed of the river is solid rock overlaid by quicksand to the depth of 2 or 3 feet. The current is never sluggish and becomes very swift during time of floods. The channel is straight for one-fourth mile above and below the station. Bench mark No. 1 is a shelf cut in the east abutment at an elevation of 29.7 feet above the zero of the gage. A cable was established later in the year at a point 335 feet above the railroad bridge. Distances across the river are marked on the cable with white paint. During the great flood of September 29 and 30, 1904, the upper portion of the gage rod was torn away but the lower portion was left intact. A new gage was installed by W. G. Russell on the east side of the second pier to replace the one which was torn out. This new portion of the gage is 2 by 6 inch by 16 feet pine timber, graduated in feet and tenths and bolted to the east face of the second pier from the north end of the bridge. The same flood cut away the earth from the face of the north abutment leaving the bench mark about 25 feet above the ground and inaccessible, so in establishing the new gage reference was made to the old gage which had not been moved by the flood. A second bench mark was placed by W. G. Russell on the east side of the first pier from the north end of the bridge. It is a chiseled surface near the top of the second stone from the downstream end of the pier, and in the second tier of stones from the bed rock, and is marked "B. M." Its elevation is 6.41 feet above the zero of the present gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Pecos River at Santa Rosa, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
April 2	W. G. Russell	45	11	0.84	1.50	9
August 7	Russell and Shely	90	78	3.08	2.50	240
August 9	do	94	64	1.64	2.10	105
August 23	L. M. Shely	94	75	1.83	2.10	137
October 30	do	60	41	1.88	2.10	77

Mean daily gage height, in feet, of Pecos River near Santa Rosa, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.65	1.65	1.60	1.60	1.40	1.40	3.50	1.30	1.60	6.00	0.70	0.50
2	.65	1.65	1.60	1.70	1.40	1.40	2.50	3.50	1.60	3.00	.70	.50
3	.65	1.65	1.60	1.70	1.40	1.40	2.50	4.00	1.60	3.00	.70	.50
4	.65	1.65	1.60	1.50	1.40	1.40	2.00	3.00	2.00	2.00	.70	.50
5	.65	1.65	1.65	1.50	1.40	1.40	2.50	2.40	1.60	2.00	.70	.50
6	.65	1.70	1.65	1.50	1.40	1.40	1.50	2.40	1.60	2.00	.60	.50
7	.65	1.70	1.65	1.45	1.40	1.40	1.40	2.50	1.60	2.00	.60	.50
8	.65	1.70	1.65	1.45	1.40	1.40	1.40	2.20	1.60	2.00	.60	.50
9	.65	1.70	1.65	1.45	1.40	1.40	1.20	2.20	1.60	2.00	.60	.50
10	1.65	1.70	1.65	1.40	1.40	1.40	1.10	4.00	1.60	2.00	.60	.50
11	1.65	1.70	1.65	1.40	1.40	1.40	1.10	2.00	1.40	2.00	.60	.50
12	1.65	1.70	1.65	1.40	1.40	1.90	1.10	2.00	1.40	2.00	.60	.50
13	1.65	1.70	1.65	1.40	1.40	1.40	1.10	2.00	1.40	2.00	.60	.50
14	1.65	1.70	1.65	1.40	1.40	3.00	1.10	2.00	1.40	2.00	.60	.50
15	1.65	1.70	1.65	1.40	1.40	2.00	1.10	1.20	1.40	2.00	.60	.50
16	1.65	1.70	1.65	1.40	1.40	2.00	1.10	1.80	1.40	2.00	.60	.50
17	1.65	1.70	1.65	1.40	1.40	2.00	3.50	1.80	1.40	2.00	.60	.50
18	1.65	1.70	1.65	1.40	1.40	1.30	2.00	1.50	1.40	1.50	.60	.50
19	1.65	1.70	1.65	1.40	1.40	3.00	3.00	1.50	1.40	1.50	.60	.50
20	1.65	1.70	1.65	1.40	1.40	2.00	2.00	1.70	1.40	1.50	.60	.50
21	1.65	1.60	1.60	1.40	1.40	1.70	2.50	1.90	1.40	1.40	.60	.50
22	1.65	1.60	1.60	1.40	1.40	4.00	2.50	1.80	1.40	1.40	.60	.50
23	1.65	1.60	1.60	1.40	1.40	1.90	2.00	1.20	1.40	1.30	.60	.50
24	1.65	1.60	1.60	1.40	1.40	1.40	2.00	1.60	1.40	1.00	.60	.50
25	1.65	1.60	1.60	1.40	1.40	1.40	2.00	1.80	1.40	.90	.60	.50
26	1.65	1.60	1.60	1.40	1.40	1.30	1.50	1.60	1.40	.90	.50	.50
27	1.65	1.60	1.55	1.40	1.40	1.20	1.20	1.60	1.40	.90	.50	.50
28	1.65	1.60	1.55	1.40	1.40	1.20	1.20	1.60	4.00	.90	.50	.50
29	1.65	1.60	1.55	1.40	1.40	1.10	1.20	1.60	13.00	.80	.50	.50
30	1.65	.....	1.55	1.40	1.40	1.40	1.30	1.60	23.00	.80	.50	.50
31	1.65	.....	1.55	.....	1.40	.....	1.30	1.60	.....	.70	.....	.50

PECOS RIVER NEAR FORT SUMNER, N. MEX.

This station was established June 12, 1904, by Earl Patterson. It is located about 12 miles northwest of Fort Sumner, N. Mex., and 45 miles south of Santa Rosa, N. Mex., the nearest railway station. It is also 1 mile upstream from the spring, trees, and houses known as Arinosa. A plain vertical staff gage, graduated to feet and tenths, is securely bolted and braced to the solid rock of a sandstone bluff on the right bank of the river. Graduations to the half foot are continued on the rock above the gage. The gage is read twice each day by Earl Patterson. Discharge measurements are made at low water by wading 20 feet below the gage, and at high stages by means of floats. The cross section has been ascertained by means of a level and rod. The initial point for soundings is a 2 by 4 inch pine stake driven into the right bank about 20 feet from the gage rod and 100 feet east of a small spring. The channel is straight for about 600 feet above and 200 feet below the station, and is very narrow. The current is swift.

Both banks are high, vertical, and not subject to overflow. The right bank is of earth and the left bank is of rock. The bed of the stream is composed of sand, and is shifting. The bench mark is a cross cut in a point of rock directly above the gage rod, on the right bank. Its elevation is 14.75 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. M. Reed, district hydrographer.

Discharge measurements of Pecos River near Fort Sumner, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
June 14 [a]	E. Patterson	194	166	1.88	3.30	313
June 14 [b]	do	170	145	1.88	3.20	276
June 16 [a]	do	171	88	1.63	3.10	144
June 16 [b]	do	265	[c] 333	3.82	4.00	1,273
June 16 [b]	do	268	[c] 413	5.28	4.30	2,183
June 20 [a]	do	63	54	1.54	2.85	84
June 21 [d]	do	63	102	3.23	2.80	330
June 21 [b]	do	256	[e] 324	3.44	3.80	1,118
June 22 [b]	do	265	[e] 717	6.96	5.30	4,993
June 23 [b]	do	258	[e] 395	4.22	4.10	1,671
June 23 [f]	do	190	170	1.76	3.10	302
June 24 [g]	do	190	132	1.68	3.00	222
June 27 [h]	do	77	68	1.35	2.50	92
June 29	do	77	52	1.46	2.40	76
July 1 [i]	do	120	70	1.51	2.60	106
July 1 [b]	do	259	[j] 495	5.08	4.40	2,519
July 1 [b]	do	261	[j] 536	4.95	4.50	2,657
July 1 [b]	do	262	[j] 560	5.43	4.60	3,046
July 2 [b]	do	270	[j] 730	6.95	5.20	5,076
July 2 [b]	do	261	[j] 642	6.05	4.90	3,889
July 2 [b]	do	262	[j] 547	5.37	4.55	2,942
July 2 [b]	do	259	[j] 370	3.74	3.90	1,420
July 3	do	216	[k] 238	2.21	3.35	528
July 4	do	210	[k] 177	2.23	3.30	395
July 5	do	167	122	1.84	3.05	225
July 6	do	126	82	1.70	2.80	139
July 15	do	49	40	1.54	2.40	62
July 17	do	44	42	1.46	2.40	61
October 15 [l]	do	401	5,473	8.25	17.95	45,160
October 15 [m]	do	241	254	2.99	1.40	761

[a] Wading.
[b] Float measurement.
[c] Sounding July 17.
[d] Made after 5-foot rise.
[e] Sounding July 24.
[f] Made after long flood.
[g] Immediately after 2½-foot rise.
[h] After flood.
[i] After small local rain.
[j] Soundings July 3.
[k] Bottom of channel changing.
[l] Kutter's formula.
[m] Wading after 18-foot rise.

Mean daily gage height, in feet, of Pecos River near Fort Sumner, N. Mex., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.60	3.25	1.70	a 4.20	0.50	0.20
2		4.70	3.20	1.65	b 10.00	.50	.20
3		3.87	4.25	3.15	2.70	.50	.20
4		3.30	3.80	1.70	2.60	.40	.40
5		3.07	3.70	1.75	1.65	.40	.40
6		2.77	3.70	1.65	2.20	.40	.40
7		2.60	3.10	1.60	1.50	.40	.40
8		2.50	3.75	1.50	1.30	.40	.40
9		2.40	2.70	1.50	2.00	.30	.40
10		2.40	3.80	1.50	2.65	.30	.40
11		2.40	2.55	1.50	2.20	.30	.....
12	3.00	3.20	1.95	1.60	1.85	.30	.....
13	3.12	2.55	1.80	1.60	1.55	.30	.....
14	3.25	2.40	1.65	2.20	1.70	.30	.....
15	3.25	2.40	1.50	1.65	c 10.00	.30	.....
16	4.00	2.50	1.50	1.60	1.20	.30	.....
17	3.20	2.40	1.70	1.60	1.15	.30	.....
18	2.97	b 2.80	1.90	1.60	1.05	.30	.....
19	2.92	b 5.50	1.90	1.60	.90	.30	.....
20	2.85	3.60	1.75	1.60	.90	.30	.....
21	3.32	3.20	1.65	1.60	.90	.30	.....
22	4.90	4.52	2.40	1.70	.85	.30	.....
23	3.77	3.10	2.20	1.70	.80	.30	.....
24	3.05	3.55	2.15	1.70	.80	.30	.....
25	2.62	3.37	1.85	1.90	.75	.30	.....
26	2.50	3.27	1.75	1.80	.60	.30	.....
27	2.50	3.70	1.70	1.70	.60	.20	.....
28	2.45	3.30	1.60	2.85	.60	.20	.....
29	2.40	3.07	1.60	1.40	.60	.20	.....
30	2.40	2.90	1.60	4.50	.60	.20	.....
31	.....	2.70	1.60	.....	.60	.....	.....

a Night of Oct. 1 gage reading 17.85. b Flood. c Morning of Oct. 15 gage reading 17.95.

Mean daily discharge, in second-feet, of Pecos River near Fort Sumner, N. Mex., for 1904.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	.....	760	380	12	180	310	.....	23	1,000	285	.....
2	.....	3,340	345	13	220	84	.....	24	260	695	.....
3	.....	540	2,050	14	295	62	.....	25	110	490	.....
4	.....	395	1,070	15	250	62	.....	26	90	400	.....
5	.....	235	910	16	1,275	76	.....	27	90	910	.....
6	.....	130	910	17	320	61	.....	28	80	420	.....
7	.....	93	285	18	180	140	.....	29	72	270	.....
8	.....	76	985	19	140	5,670	.....	30	72	193	.....
9	.....	62	132	20	84	760	.....	31	.....	132	.....
10	.....	62	1,070	21	600	345	.....				
11	.....	62	100	22	3,940	2,820	.....				

Daily discharge obtained from discharge measurements, taking into account the time interval, gage height, and the change in bed.

Estimated monthly discharge[a] of Pecos River near Fort Sumner, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 12–30	3,940	72	487	18,350
July	5,670	61	643	39,540
August 1–11	2,050	100	749	16,340

[a] See footnote to daily discharges.

PECOS RIVER NEAR ROSWELL, N. MEX.

This station was established April 24, 1903, by W. M. Reed. It is located at the highway bridge 8 miles southeast of Roswell, N. Mex., and about 200 feet below the mouth of Hondo River. The gage is painted on the right side of the right pier of the bridge. It is read twice each day by Miss Dovie Goldsmith. Discharge measurements are made from the highway bridge at the gage. The initial point for soundings is a zero marked on the guard rail at the west end and north side of the bridge. The channel is straight for one-half mile above and below the station, and has a width at low water of about 50 feet and at ordinary high water of 430 feet. The channel is broken by three iron piers. The current is rapid except near the mouth of Hondo River, where it becomes sluggish. At high water the Pecos and the Hondo join above the bridge. The gage heights on the Pecos may be effected by back water at periods when the Pecos is low and the Hondo is high. Both banks are high and free from timber, but overflow at extreme flood stages. The bed is sandy and shifting and the cross section changes during each flood. The bench mark is the top of the pier upon which the gage is painted. Its elevation is 20.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. M. Reed, district hydrographer.

Discharge measurements of Pecos River near Roswell, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
March 5	H. C. Hurd	46	[a] 37	1.30	3.30	48
March 29	F. L. Dobson	35	27.5	1.06	3.20	29
May 20	do	120	98	.45	3.20	44
June 24	J. M. Roberts	365	805	2.88	5.40	2,322
July 27	F. L. Dobson	70	160	3.14	4.50	505
September 1	do	40	[b] 62	.81	2.96	50
September 16	do	70	134	2.18	3.70	291
November 28	do	876	22,236	2.50	17.40	[c] 55,690

[a] River bottom filled with quicksand which is constantly changing; this accounts for changing area
[b] Low water cross section changed owing to recent floods.
[c] Kutter's formula.

Mean daily gage height, in feet, of Pecos River near Roswell, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.00	3.85	3.45	3.35	3.20	3.25	4.45	4.00	2.96	16.45	2.60
2	4.00	3.85	3.45	3.35	3.10	3.20	3.80	4.00	2.96	15.00	2.60
3	4.00	3.85	3.45	3.35	3.15	3.20	5.80	4.45	3.80	.....	2.60
4	4.00	3.85	3.40	3.35	3.20	3.15	4.60	5.00	5.50	.....	2.60
5	4.00	3.85	3.40	3.35	3.20	3.10	4.40	4.20	4.05	4.00	2.60
6	4.00	3.80	3.35	3.40	3.25	3.10	4.45	5.10	3.90	3.90	2.60
7	4.00	3.80	3.30	3.60	3.25	3.10	3.80	4.80	3.70	3.75	2.60
8	4.00	3.80	3.25	3.50	3.25	3.10	3.65	4.70	3.70	.....	2.60
9	4.00	3.80	3.25	3.45	3.20	3.10	3.60	5.20	3.50	6.45	2.60
10	4.00	3.80	3.20	3.45	3.20	3.10	3.60	5.00	3.20	4.45	2.60
11	4.00	3.75	3.20	3.45	3.20	3.10	3.55	5.00	3.20	5.00	2.60
12	4.00	3.75	3.20	3.40	3.20	3.10	3.55	5.00	3.20	4.45	2.55
13	4.00	3.75	3.20	3.40	3.20	4.00	3.40	5.00	3.20	4.00	2.55
14	4.00	3.75	3.10	3.35	3.20	4.45	3.35	5.00	3.95	3.35	2.55
15	4.00	3.75	3.10	3.35	3.25	4.45	3.30	4.70	4.45	3.20	2.55
16	4.00	3.75	3.15	3.35	3.25	4.15	3.20	4.60	3.70	4.00	2.40
17	4.00	3.70	3.20	3.45	3.20	4.10	3.20	4.00	3.95	3.00	2.40
18	4.00	3.65	3.20	3.35	3.20	4.20	3.10	4.10	3.45	3.00	2.40
19	4.00	3.65	3.25	3.35	3.20	4.00	3.65	3.88	3.00	2.80	2.35
20	4.00	3.60	3.25	3.35	3.20	4.00	5.45	3.88	2.95	2.70	2.35
21	3.85	3.55	3.25	3.30	3.25	3.75	5.10	3.88	2.45	2.70	2.30
22	3.85	3.50	3.25	3.30	3.35	3.70	5.00	3.63	2.90	2.70	2.30
23	3.85	3.45	3.25	3.30	3.40	5.75	5.45	3.63	3.20	2.65	2.30
24	3.85	3.45	3.30	3.30	3.75	6.00	4.45	3.29	3.45	2.65	2.30
25	3.85	3.45	3.30	3.25	3.60	4.45	4.45	3.13	3.50	2.65	2.20
26	3.85	3.45	3.35	3.50	3.65	4.25	4.50	3.13	3.90	2.65	2.00
27	3.85	3.45	3.25	3.30	3.75	3.80	4.30	2.96	3.50	2.65	.....
28	3.85	3.45	3.35	3.25	3.65	3.75	4.10	2.96	3.65	2.65	.....
29	3.80	3.45	3.35	3.25	3.45	3.65	4.10	2.96	5.50	2.65	.....
30	3.80	.....	3.35	3.25	3.25	3.55	4.00	3.13	16.45	2.80	.....
31	3.00	.....	3.35	.....	3.20	.....	4.00	3.13	.....	2.80	.....

PECOS RIVER AT CARLSBAD, N. MEX.

This station was established May 20, 1903, by V. L. Sullivan, acting under the direction of W. M. Reed. It is located at the Green Street Bridge, Carlsbad, N. Mex., and is about 500 feet below the station of the Pecos Valley and Northeastern Railway and 2,000 feet below the Hagerman power dam. The gage consists of a 2 by 8 inch plank securely spiked at an inclination of 10° with the vertical to the timbers of the third bent from the west end of the bridge. It is painted white and graduated in black to vertical feet and tenths. Readings are taken twice daily by V. L. Sullivan, a civil engineer in the employ of the Pecos Valley Irrigation Company. Discharge measurements are made by wading when the stage of the river will permit, and from the lower side of the bridge during floods. The initial point for soundings is on the south side of the bridge at the west abutment, and 10-foot intervals are marked on the rail. Both banks are high and not subject to overflow. The bed of the river is solid rock, much corrugated, which makes low-water measurements subject to considerable inaccuracy. The channel is straight for some distance above and below the station. The current is swift at the station, but sluggish both above and below. The only bench mark is the initial point for soundings, which is 22.30 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. M. Reed, district hydrographer.

Discharge measurements of Pecos River at Carlsbad, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
March 30	F. S. Dobson	100	45	1.17	0.55	52
May 27	V. L. Sullivan	100	54	2.85	.75	112
August 15	do	125	113	2.36	1.10	267

Mean daily gage height, in feet, of Pecos River at Carlsbad, N. Mex., for 1904.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.64	0.84	0.68	0.68	0.67	0.67	0.70	0.73	0.74	3.45	2.80	1.87
2	.64	.74	.68	.68	.67	.67	.70	.73	.74	a11.00	2.80	1.87
3	.65	.70	.68	.67	.67	.67	.70	.73	.74	.....	2.63	1.87
4	.....	.70	.68	.67	.69	.67	.70	.73	.74	.....	2.42	1.8
5	.65	.70	.68	.67	.75	.....	.70	.73	.74	.....	2.39	1.8
6	.65	.70	.68	.67	.70	.69	.70	1.40	.74	.....	2.28	1.85
7	.65	.70	.30	.67	.68	.69	.70	.74	.74	.....	2.19	1.84
8	.65	.70	.41	.67	.34	.72	.70	.74	.74	.....	2.15	1.8
9	.65	.70	.56	.67	.00	.69	.70	.74	.74	.....	2.11	1.8
10	.65	.69	.68	.67	.67	.69	.70	.74	.74	.....	1.30	1.81
11	.66	.69	.63	.67	.67	.69	.70	.74	.74	7.60	1.18	1.80
12	.66	.69	.83	.67	.67	.79	.70	.74	.74	5.90	1.13	1.79
13	.66	.....	.....	.67	.67	.69	.70	1.13	.74	5.45	1.15	1.20
14	.66	.69	.69	.67	.67	.69	.70	1.13	.98	4.85	1.10	1.19
15	.66	.69	.69	.67	.67	.69	.70	1.13	1.00	5.05	1.10	1.18
16	.67	.68	.69	.67	.67	.69	.70	.75	1.03	4.30	1.10	1.18
17	.67	.68	.69	.67	.67	.69	.70	.74	1.03	4.07	1.10	1.18
18	.67	.68	.69	.67	.67	.69	.70	.74	1.03	4.00	1.30	1.18
19	.67	.68	.69	.67	.67	.72	.74	.74	1.03	3.75	1.40	1.18
20	.67	.68	.69	.67	.67	.69	.73	.74	1.03	3.55	1.40	1.18
21	.67	.68	.69	.67	.67	.69	.70	.74	.98	3.33	1.40	1.19
22	.67	.68	.69	.67	.67	.62	.70	.74	.98	3.05	1.40	1.20
23	.88	.68	.69	.67	.67	.62	.70	.74	.96	2.85	1.40	1.21
24	.88	.68	.69	.67	.67	.62	.70	.74	.93	2.66	1.68	1.22
25	.86	.68	.69	.67	.67	.62	.70	.74	.93	2.52	1.90	.....
26	.77	.68	.69	.67	.67	.75	.70	.74	.88	2.41	1.88	.....
27	.73	.68	.69	.67	.67	.69	.70	.74	.83	2.40	1.88	.....
28	.75	.68	.59	.67	.67	.69	.72	.74	.83	2.40	1.88	.....
29	.76	.68	.58	.67	.....	.69	.72	.74	.83	2.40	1.88	.....
30	.89	.....	.58	.67	.67	.70	.72	.74	.83	2.41	1.88	.....
31	.88	.....	.58	.....	.67	.....	.72	.74	.....	2.65	.....	.....

a Gage and bridge washed out.

PECOS RIVER AND MARGUERETTA FLUME NEAR PECOS, TEX.

The summer flow of Pecos River is largely dependent upon numerous springs which occur in the limestone country in the vicinity of Roswell and Carlsbad. Owing to the numerous diversions for irrigating purposes, however, the river would be dry in the summer where it crosses into Texas were it not for the waters which are gradually returning to the river through seepage and for the various springs that occur below Carlsbad, N. Mex. This water, unfortunately, is impregnated to a considerable extent with alkali, which renders it undesirable for irrigating purposes.

The station on Pecos River was established January 1, 1898, by Thomas U. Taylor, and is located about 6 miles above Pecos, Tex., at the flume of the Barstow Irrigation Company (old Margueretta Canal Company). This canal diverts the water from Pecos River 3 miles above the flume from the west side of the river. The main canal flows for 3 miles on the west side of the river and then is taken by the

flume across Pecos River to the east side. However, before it reaches the flume the West Valley canal is taken out of the main canal and is made to carry water to the alfalfa farms on the west side of the river. The gage consists of a graduated strip of wood attached to one of the vertical bents of the flume on the upper side of the same. Discharge measurements are made by means of a cable and car, about 600 feet below the flume. No measurements were made during the flood of October, 1904, on account of the cable support and anchorage at the west end being completely washed out. The channel is straight for 75 feet above and several hundred feet below the station. Its width at low water is about 20 feet and at high water is 200 feet. The bed is sandy and shifting. The velocity is poorly distributed and is affected by the aqueduct. In the flume conditions are favorable for accurate measurement. The gage heights on the flume are obtained by measuring the depths of the water in the flume at the west end. The zero of this gage is at the bottom of the flume. The gages of the river have no connection with each other except that they are geographically at the same place on the river and have the same observer, Willard H. Denis, who reads both gages. For the years 1901 to 1904 Mr. Denis has also taken the measurements of the flow of the Pecos and the flume at this station. The canal measurements are made above the flume by wading, a wire being stretched across the river and tagged every 4 feet. Flood discharge measurements are made at a highway bridge east of Pecos. Bench mark No. 1 is the top of the west abutment or pier on the north side. Its elevation is 21.70 feet above the datum of the gage, and is marked "U. S. G. S. B. M. 21.70." Bench mark No. 2 is on the south side of the canal under the window of the water master of the irrigation company, and is marked "U. S. G. S. B. M. 20.95." Its elevation is 20.95 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of Thomas U. Taylor, district hydrographer.

Discharge measurements of Pecos River near Pecos, Tex., in 1904.

Date.	Hydrographer.	Gage height.	Discharge in second-feet.		
			River.	Flume.	West Valley ditch.
		Feet.			
July 20	T. U. Taylor	0.90	5.5		
August 24	W. H. Denis	5.60	763	248	0
August 25	do	4.50	473	240	0
September 25	do	6.30	1,000	95	0
September 26	do	5.40	760	95	0

Mean daily discharge, in second-feet, of West Valley ditch near Pecos, Tex., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1		8		8	4	8	17	6		4		10	6
2		8		8	4	8	18	6		4		10	6
3		8		8		8	19	6		4	6	10	6
4		8		8		8	20	6		4	6	10	6
5		6		8		8	21	6		4	6	10	
6	4	6		8		8	22	6			6	12	
7	4	6		8			23	6			6	12	
8	4	6	8	8			24	6			6	12	
9	4	6	8	8			25	6			6	12	
10	4		8	8	8		26	6			4	12	
11	4		8	8	8		27	8			4	12	
12	4		8		8		28	8			4	12	
13	6		8		8		29	8		8	4	12	
14	6		8		8	8	30	8		8	4	12	
15	6		4		8	6	31	8		8		8	
16	6		4		8	6							

Mean daily gage height, in feet, of Pecos River near Pecos, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.70	2.50	1.40	1.20	0.90	0.90	2.20	0.90	1.10	3.50	5.90	4.10
2	1.70	2.50	1.40	1.20	.90	.90	1.30	.90	1.10	3.50	5.80	4.10
3	1.70	2.50	1.40	1.20	.90	.90	1.00	.90	1.10	7.00	6.00	4.10
4	1.70	2.50	1.40	1.20	.90	.90	1.00	.90	6.00	9.00	6.00	5.30
5	1.70	2.50	1.30	1.00	.90	.90	1.00	1.00	4.00	19.00	5.90	5.00
6	1.50	2.40	1.40	1.00	.90	.90	1.00	1.50	3.20	17.00	5.50	5.00
7	1.50	1.80	1.30	1.00	.90	.90	1.00	1.50	3.00	15.50	5.50	5.00
8	1.50	1.80	1.30	1.00	.90	.90	1.00	5.50	3.00	13.00	5.50	4.90
9	1.50	1.80	1.30	1.00	.90	.90	1.00	4.20	3.00	13.00	5.50	4.90
10	1.80	1.80	1.30	1.00	.90	.90	.90	2.00	3.00	11.00	5.40	4.90
11	1.90	1.80	1.30	1.00	.90	.90	.90	1.50	2.60	10.50	5.40	4.80
12	2.00	1.80	1.30	1.00	.90	.90	.90	1.30	2.40	14.00	5.20	4.60
13	2.00	1.80	1.30	1.00	.90	.90	.90	1.30	3.00	13.00	4.10	4.40
14	2.00	1.80	1.30	1.00	.90	.90	.90	1.30	3.50	12.00	4.10	3.80
15	2.00	1.30	1.30	1.00	.90	.90	.90	1.30	5.00	9.00	4.10	3.80
16	2.00	1.30	1.30	1.00	.90	.90	.90	1.30	4.50	8.40	4.00	3.80
17	2.00	1.30	1.30	1.00	.90	.90	.90	1.60	4.50	8.20	4.00	3.50
18	2.00	1.30	1.30	1.00	.90	.90	.90	1.50	3.00	8.10	3.90	3.30
19	1.90	1.30	1.30	1.00	.90	.90	.90	1.40	3.00	7.80	3.90	3.00
20	1.90	1.30	1.10	1.00	.90	.90	.90	1.30	2.90	7.30	4.10	2.80
21	1.90	1.30	1.10	1.00	1.00	.90	2.10	1.00	2.80	7.00	4.00	2.60
22	1.90	1.30	1.10	1.00	1.00	.90	1.50	1.00	2.80	7.00	4.00	2.40
23	1.80	1.30	1.10	1.00	6.50	.90	1.30	1.00	3.00	6.90	4.00	2.30
24	1.80	1.30	1.10	.90	4.50	.90	1.30	6.00	3.00	6.80	3.90	2.20
25	1.80	1.30	1.10	.90	2.40	.90	1.30	3.00	7.00	6.50	3.90	2.0
26	1.80	2.50	1.10	.90	2.20	.90	1.10	2.50	5.20	5.00	3.90	2.00
27	2.40	1.30	1.20	.90	1.80	4.00	1.10	2.00	4.50	5.00	4.00	2.0
28	2.40	1.30	1.20	.90	1.00	4.50	1.10	1.50	4.20	5.00	4.00	2.0
29	2.30	1.30	1.20	.90	.90	3.00	1.00	1.50	3.50	4.90	4.00	2.0
30	2.30		1.20	.90	.90	3.00	.90	1.40	3.00	6.00	4.00	2.0
31	2.30		1.20		.90		.90	1.30		6.00		2.0

Mean daily gage height, in feet, of flume of the Barstow Irrigation Company[a] near Pecos, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.1	2.0	2.0	1.8	0.9	1.4	2.0	0.6	2.1	1.8
2	2.1	2.0	2.0	1.8	.9	1.2	1.6	.6	2.0	1.7
3	2.1	2.0	2.0	1.1	.9	1.0	2.0	.7	2.1	1.8
4	2.1	2.0	2.0	1.2	.9	1.0	2.0	.7	2.5	1.8
5	2.1	2.0	2.0	1.5	.9	1.0	2.0	2.1	2.4	(b)
6	2.0	2.0	1.4	1.4	.9	.9	1.9	2.5	2.4	.....
7	2.0	2.1	1.3	1.4	1.0	.8	1.9	2.3	1.4	.....
8	2.1	2.1	1.3	1.4	1.0	.7	1.8	3.2	1.4	.....
9	2.1	2.1	1.3	1.4	1.4	.7	1.3	3.1	1.4	.....
10	2.0	2.1	1.3	1.5	1.4	.7	1.3	3.0	1.0	.....
11	1.8	2.1	1.2	1.4	1.5	1.4	1.3	3.0	1.0	.....
12	1.8	2.1	1.1	1.4	1.6	1.4	1.3	2.0	1.6	.....
13	1.8	2.1	1.2	1.4	1.3	1.4	1.3	1.6	1.0	.....
14	1.8	2.1	1.2	1.4	1.0	1.4	1.2	1.6	.4	.....
15	1.8	2.3	1.2	1.9	1.0	1.4	1.0	1.6	.4	.....
16	1.8	2.3	1.4	2.1	.4	1.3	.9	2.0	.4	.....
17	1.8	2.3	1.4	2.1	.4	1.3	1.3	1.9	.6	.....
18	1.8	2.3	1.4	2.0	.4	1.0	1.9	1.9	1.3	.....
19	1.8	2.3	1.4	1.0	.5	1.4	1.6	1.9	.9	.....
20	1.8	2.3	1.4	1.5	.9	1.5	1.5	2.2	.9	.....
21	1.8	2.3	1.4	1.6	1.0	1.3	2.6	1.9	1.0	.....
22	1.8	2.3	1.4	1.6	1.5	1.3	2.0	1.9	1.0	.....
23	2.0	2.3	1.4	1.5	2.2	1.3	2.1	1.9	1.8	.....
24	2.0	2.3	1.4	1.0	2.2	1.3	1.9	2.8	1.7	.....
25	2.0	2.3	1.4	1.0	2.3	1.1	1.5	3.0	1.9	.....
26	2.0	0.5	1.4	1.0	2.0	1.5	1.6	2.8	1.7	.....
27	2.0	2.2	1.1	1.0	1.9	2.5	1.5	2.7	1.7	.....
28	2.0	2.0	1.8	1.0	1.6	3.3	1.5	2.6	1.8	.....
29	2.0	2.0	1.8	1.0	1.5	3.3	1.0	2.6	1.8	.....
30	1.8	.....	1.8	1.0	1.5	3.3	.9	2.5	1.8	.....
31	2.0	.....	1.8	.....	1.4	.....	.6	2.4	.....	.....

[a] Old Margueretta Canal Company.

[b] Flume destroyed by flood.

Rating table for Pecos River near Pecos, Tex., from January 1 to October 4, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	6	2.20	79	3.50	255	4.80	550
1.00	9	2.30	88	3.60	274	4.90	577
1.10	12	2.40	98	3.70	294	5.00	604
1.20	16	2.50	108	3.80	315	5.20	660
1.30	20	2.60	119	3.90	336	5.40	718
1.40	25	2.70	131	4.00	358	5.60	779
1.50	30	2.80	143	4.10	380	5.80	842
1.60	36	2.90	156	4.20	403	6.00	907
1.70	42	3.00	170	4.30	426	6.50	1,080
1.80	49	3.10	185	4.40	450	7.00	1,265
1.90	56	3.20	201	4.50	474		
2.00	63	3.30	218	4.60	499		
2.10	71	3.40	236	4.70	524		

The above table is based upon 5 discharge measurements made during 1904 and the general form of the 1903 curve. The section has filled materially during the low-water periods of 1903 and 1904, but the curve can be considered as representing the flow fairly well to October 4, 1904. Owing to the probable change in section during the October floods estimates for the last three months are withheld.

Rating table for flume of the Barstow Irrigation Company near Pecos, Tex., from January 1 to October 4, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	7	1.20	37	2.00	107	2.80	233
.50	10	1.30	43	2.10	120	2.90	252
.60	13	1.40	50	2.20	134	3.00	271
.70	16	1.50	57	2.30	149	3.10	291
.80	19	1.60	65	2.40	164	3.20	311
.90	23	1.70	74	2.50	180	3.30	332
1.00	27	1.80	84	2.60	197		
1.10	32	1.90	95	2.70	215		

The above table is based upon discharge measurements made during 1903 and 1904. It is fairly well defined.

NOTE.—Flume was carried away by the flood of October 5, 1904.

Estimated monthly discharge[a] of Pecos River near Pecos, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	205	140	157	9,654
February	215	118	173	9,951
March	132	48	78.3	4,814
April	129	33	64.3	3,826
May	1,214	13	111	6,825
June	806	22	116	6,902
July	268	19	83.7	5,146
August	1,140	19	238	14,630
September	1,360	119	357	21,240
October 1–4	1,749	329	1,022	8,108

[a] Includes flume of the Barstow Irrigation Company, but not West Valley ditch.

PECOS RIVER NEAR MOORHEAD, TEX.

This station was established by the International (Water) Boundary Commission in April, 1900. It is near Moorhead, immediately above the high bridge of the Southern Pacific Railway.

The observations at this station during 1904 have been made under the direction of the International (Water) Boundary Commission.

Discharge measurements of Pecos River near Moorhead, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 4	J. D. Dillard	659	0.36	0.9	234
January 8	do	660	.35	.9	228
January 13	do	654	.31	.85	201
January 19	do	653	.31	.85	201
January 24	do	650	.29	.8	191
January 29	do	650	.29	.8	191
February 3	do	647	.29	.8	190
February 8	do	644	.28	.8	178
February 13	do	646	.28	.8	183
February 18	do	668	.34	.9	225
February 23	do	659	.31	.9	204
February 28	do	662	.32	.9	213
March 4	do	645	.28	.8	180
March 9	do	644	.28	.8	181
March 14	do	644	.27	.8	174

Discharge measurements of Pecos River near Moorhead, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
March 19	J. D. Dillard	638	0.25	0.75	162
March 28	do	618	.25	.65	157
April 2	do	614	.21	.6	128
April 7	do	625	.20	.6	126
April 14	do	625	.20	.6	128
April 19	do	609	.20	.55	123
April 25	do	609	.21	.55	130
April 29	do	612	.20	.55	125
May 4	do	624	.19	.55	121
May 8	do	641	.25	.75	161
May 13	do	591	.19	.5	112
May 19	do	619	.19	.5	117
May 26	do	958	2.33	3.6	2,230
May 30	do	828	1.34	2.5	1,110
June 3	do	682	.49	1.25	335
June 8	do	1,092	3.11	4.8	3,401
June 13	do	811	1.02	2.0	831
June 17	do	717	.50	1.3	355
June 22	do	696	.36	1.05	254
June 29	do	1,083	2.98	4.35	3,223
July 7	E. E. Winter	764	.84	1.6	639
July 13	do	781	.86	1.7	675
July 16	do	667	.42	1.0	283
July 23	do	674	.42	1.0	286
July 27	do	677	.43	1.0	289
July 31	do	677	.44	1.0	296
August 5	do	625	.38	.8	235
August 10	do	636	.35	.8	223
August 15	do	636	.36	.8	229
August 19	do	660	.43	.85	285
August 24	do	638	.41	.75	261
August 27	do	636	.39	.75	250
August 31	do	630	.38	.75	238
September 3	do	631	.35	.7	221
September 8	do	964	1.57	2.5	1,513
September 15	do	766	.66	1.5	508
September 17	do	809	.75	1.9	609
September 22	do	899	1.53	2.5	1,379
September 24	do	828	1.22	2.1	1,007
September 29	do	826	.78	1.9	646

Discharge measurements of Pecos River near Moorhead, Tex., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
October 5	E. E. Winter	805	0.84	1.7	674
October 8	do	844	1.07	2.6	902
October 10	do	1,004	1.98	3.5	1,986
October 14	do	1,058	2.00	3.8	2,116
October 17	do	1,154	2.99	4.5	3,451
October 23	do	1,294	4.40	5.4	5,695
October 30	do	1,028	3.05	4.2	3,138
November 3	do	946	2.10	3.2	1,983
November 7	do	842	1.81	2.8	1,521
November 11	do	872	2.20	3.0	1,919
November 15	do	822	2.03	2.9	1,667
November 18	do	794	1.77	2.7	1,404
November 22	do	812	1.21	2.3	983
November 26	do	824	1.47	2.5	1,215
November 30	do	801	1.26	2.3	1,013
December 5	do	824	1.07	2.3	882
December 9	do	822	1.08	2.3	889
December 13	do	808	.99	2.2	797
December 17	do	805	.99	2.2	798
December 21	do	802	1.01	2.2	813
December 29	do	719	.94	1.75	674

Mean daily gage height, in feet, of Pecos River near Moorhead, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	0.8	0.9	0.6	0.55	1.6	2.0	0.9	0.7	2.05	3.35	2.
2	.85	.8	.85	.6	.55	1.25	2.0	.85	.7	2.25	3.25	2.
3	.85	.8	.8	.7	.55	1.25	2.0	.85	.7	1.95	3.2	2.
4	.9	.8	.8	.7	.55	1.05	2.0	.8	.7	1.8	3.05	2.
5	.9	.8	.8	.7	1.15	1.25	1.9	.8	.9	1.75	3.0	2.
6	.9	.8	.8	.65	1.1	4.85	1.85	.8	3.25	1.7	2.95	2.
7	.9	.8	.8	.6	.8	5.95	1.8	.8	10.1	1.6	2.85	2.
8	.9	.8	.8	.6	.75	3.75	1.8	.8	2.4	2.1	3.75	2.
9	.85	.8	.8	.6	.7	2.0	1.75	.8	2.45	2.9	3.7	2.
10	.85	.8	.8	.6	.7	1.95	1.65	.9	1.4	3.3	3.45	2.
11	.85	.8	.8	.6	.65	2.55	1.5	.8	1.7	3.3	3.0	2.
12	.85	.8	.8	.6	.6	2.9	1.55	.8	1.7	3.45	2.9	2.
13	.85	.8	.8	.6	.5	1.95	1.55	.8	1.75	3.65	2.9	2.
14	.85	.8	.8	.6	.5	1.65	1.1	.75	1.65	3.75	2.9	2.
15	.85	.8	.8	.6	.5	1.5	1.05	.8	1.6	4.1	2.85	2.
16	.85	.8	.8	.6	.5	1.45	1.0	.8	1.5	4.3	2.8	2.
17	.85	.8	.75	.55	.5	1.35	1.0	.8	1.75	4.45	2.75	2.
18	.85	.9	.75	.55	.5	1.25	1.05	.8	1.95	4.6	2.6	2.
19	.85	.9	.75	.55	.5	1.2	1.1	.8	1.85	4.75	2.45	2.
20	.85	.9	.7	.55	.6	1.15	1.05	.8	13.6	4.9	2.4	2.
21	.85	.95	.7	.55	.55	1.1	1.0	.8	4.6	5.0	2.3	2.
22	.85	1.1	.7	.75	.5	1.05	1.0	.8	3.25	5.05	2.3	2.
23	.85	.95	.7	.65	.5	1.0	1.0	.8	2.95	5.35	2.2	2.
24	.8	.9	.7	.6	.5	.95	1.1	.75	2.1	5.3	2.1	1.
25	.8	.9	.7	.55	.5	.9	1.1	.75	2.0	5.2	2.2	1.
26	.8	.9	.7	.55	2.5	.8	1.0	.75	2.0	5.05	2.5	1.
27	.8	.9	.65	.55	1.55	11.45	1.0	.75	1.9	4.8	2.5	1.
28	.8	.9	.65	.5	1.55	11.4	1.0	.75	1.9	4.4	2.4	1.
29	.8	.9	.65	.6	4.0	4.2	1.0	.75	1.9	4.0	2.35	1.
30	.8	.....	.6	.6	2.6	2.75	1.0	.75	2.35	3.9	2.3	1.
31	.8	.....	.6	.....	1.95	.....	1.0	.75	.....	3.55	.....	1.

Mean daily discharge, in second-feet, of Pecos River near Moorhead, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	210	190	215	140	120	565	860	265	220	980	2,040	985
2	210	190	200	a 130	120	335	860	250	220	1,150	2,000	660
3	210	a 190	185	150	120	a 335	860	250	a 220	890	a 1,980	830
4	a 235	190	a 180	150	a 120	255	860	235	220	760	1,810	905
5	235	185	180	150	300	335	800	a 235	270	a 715	1,750	a 880
6	230	185	180	140	285	3,460	770	235	1,980	675	1,690	830
7	230	180	180	a 125	180	4,790	a 740	230	10,600	590	a 1,580	835
8	a 230	a 180	180	125	a 160	a 2,300	740	230	a 1,410	a 700	2,700	840
9	210	180	a 180	125	150	830	710	225	1,460	1,260	2,680	a 890
10	205	180	180	125	150	800	660	a 255	450	a 1,740	2,420	890
11	205	180	180	125	140	1,270	580	225	710	1,740	a 1,920	845
12	200	180	175	130	130	1,550	600	225	710	1,830	1,770	845
13	a 200	a 185	175	130	a 110	a 800	a 600	225	760	2,050	1,740	a 845
14	200	185	a 175	a 130	110	595	335	210	660	a 2,095	1,700	795
15	200	185	175	130	115	490	310	a 230	a 610	2,630	a 1,600	795
16	200	185	170	130	115	455	a 285	230	510	3,010	1,530	800
17	200	185	160	125	115	a 390	285	285	a 570	a 3,340	1,470	a 800
18	200	a 225	160	125	a 115	335	310	240	650	3,680	a 1,290	800
19	a 200	225	a 160	a 125	115	315	335	a 245	590	4,040	1,130	805
20	200	225	160	125	135	296	310	250	17,500	4,410	1,080	810
21	200	240	160	125	125	275	285	260	3,180	4,660	980	a 815
22	200	285	160	150	115	a 255	285	270	a 1,980	4,790	a 980	815
23	200	a 225	160	140	115	240	a 285	280	1,740	a 5,570	880	770
24	a 190	205	160	135	115	225	335	a 260	a 1,010	5,460	780	740
25	190	205	160	a 130	115	210	335	260	830	5,220	890	720
26	190	210	160	130	a 1,110	180	285	255	830	4,880	a 1,210	690
27	190	210	155	130	530	13,000	a 290	a 250	650	4,360	1,210	690
28	190	a 215	a 155	120	530	12,900	290	250	650	3,520	1,110	690
29	a 190	215	155	a 130	2,630	a 3,070	290	245	a 650	2,780	1,060	a 675
30	190	.....	150	130	a 1,210	1,430	295	240	1,240	a 2,620	a 1,010	675
31	190	.....	150	.....	795	.....	a 295	a 240	.....	2,130	.....	675

a Meter measurements.

Estimated monthly discharge of Pecos River near Moorhead, Tex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	235	190	204	12,555
February	285	180	201	11,544
March	215	150	170	10,463
April	150	120	132	7,845
May	2,630	110	332	20,429
June	13,000	180	1,743	103,706
July	860	285	486	29,911
August	280	210	243	14,945
September	17,500	220	1,769	105,283
October	5,570	590	2,719	167,157
November	2,700	780	1,533	91,220
December	985	660	795	48,873
The year	17,500	110	861	623,922

THE PECOS FLOOD OF 1904.

During the latter part of September, 1904, a remarkably heavy rainfall (mostly on the 28th and 29th) occurred in New Mexico, the greater portion of which being in the eastern half of the Territory, and the heaviest rain in this section was in the northern part. Just west of Roswell, another separate area, about 125 miles long and 50 wide, had a similar increase of rainfall above the general average. Arrabella and Hot Springs, N. Mex., seemed to be the two centers of the greatest precipitation in the Pecos Valley drainage. An observer near the headwaters of Pecos River says:

> Between the 26th and 30th of September, 1904, very heavy steady rains fell over nearly the entire Territory. The greatest damage occurred on Thursday morning, September 29, over the eastern slopes of the mountains and along the valleys and lowlands of the northern portion, but the floods were nearly as destructive over the eastern slope of the several mountain ranges in the southwest portion and over the Hondo in the southeast. In an area 500 by 300 miles reports show that a rainfall of from 3 to 7 inches fell within the space of from twenty-four to forty-eight hours.

The flood waters reached Roswell, N. Mex., on September 29, and in the evening of that day the water broke over the banks of the Hondo at 8 p. m., and in fifteen minutes the main street of that city was under water, and the dike, erected for the protection of the city, swept away, likewise the railroad bridge north of the city. The flood at this place lasted about four days, but lines of communication were so damaged that no mail was delivered until October 10. The opera house and about fifteen dwellings were destroyed.

The crest of the flood reached Carlsbad, N. Mex., at 3 a. m., October 2. The irrigation works were badly damaged, the cotton gin and all bridges on Pecos River swept away, and the railway track for miles up and down the river was submerged.

On October 3 the water reached a height of 9 feet on the United States Geological Survey gage 6 miles above Pecos, N. Mex., and it continued to rise slowly for about forty-eight hours. This rise was so gradual that it could scarcely be noted from hour to hour. At 10 p. m. on October 4 it began to rise on the gage at the rate of about 1 foot per hour, and about this time four leaks occurred in the levees of the Barstow Irrigation Company 3½ miles above the flume, on the west side of the river, and which were built to protect the West Valley system from flood waters. This water soon entered the canals, and by 3 a. m., October 5, the canals were filled and soon overflowed so rapidly that many breaks were made in the West Valley canals. Daybreak of October 5 showed a sluggish flood of murky red and gray spread from one-half to 2½ miles in width on either side of the river. The current in the main channel of the river did not seem as boisterous as on the previous days, but at many points along the river currents were running out over the banks into and through the surrounding flats, covering the whole country to the foothills from 2 to 4 feet deep. At 8 a. m., with 19 feet by gage, the flume gave two little snaps, its center bowed downstream, the ends tore loose, the flume slowly rose, emptied its water, broke in two, and the two hulks floated downstream. These two parts, each about 100 feet in length, finally grounded, the one about 1¼ miles below the flume, and the other at a point about 5 miles below, where it had caught on the banks of the river and formed a perfect bridge across the river channel. This section of the flume held this position till the gage read 10.50, but on the night of October 12 a small rise raised the water on the gage to 14, and in the meantime drift had caught above this part of the flume, and the added force carried the broken flume on down the river to the highway bridge east of Pecos City, where it passed under in some almost miraculous manner and caught against the railroad bridge a few hundred feet below. It was soon wrecked sufficiently to allow it to pass under this bridge. It may be remarked here that these two bridges (about 1 mile east of Pecos City) were the only structures that remained across Pecos River during the flood. This was due to the fact that at high water a large portion of the flood waters (perhaps half) flow out on the east side of the river channel and through a quarter-mile trestlework on the Texas and Pacific Railway.

On October 15 the gage at the flume read 9 feet, thus showing that the flood that swept through Roswell, N. Mex., in about three days had spread out enough to make some ten days of extremely high water

near Pecos. About October 20 most of the outlying water had drained back and it had left a deposit of reddish clay and fine sand where the water was sluggish and coarse sand where the water was swift. The depth of this deposit varied from 0.20 to 0.40 feet, except at certain isolated points where a deposit of over 1 foot was left.

Above the main canal of the Barstow Irrigation Company, on the east side of the river, the water reached a depth of 4 feet, and it required a period of two weeks to drain this water off.

After the flume went out on October 5 the water level dropped about 0.30, showing that the flume had little effect on holding the water back. On the west side of the river two-thirds of the alfalfa was killed by the flood and about 50 per cent of the cotton was lost. Out of 900 acres 700 were flooded. On the east side some thousand acres were heavily flooded and as much more lightly flooded. The sorghum was injured very slightly, but from 25 to 50 per cent of the cotton heavily flooded was lost. Very few of the plants were killed, but the bolls were so soaked that they soured and were ruined.

This flood did its greatest damage at its inception in New Mexico, and the damage became less as it approached the Rio Grande. The flood was caused by concentrated floods in two localities in New Mexico, and below Carlsbad the rainfall was moderate, and it decreased in intensity to the south.

GALLINAS RIVER NEAR LAS VEGAS, N. MEX.

This station was established August 13, 1903, by E. G. Marsh, assisted by R. B. Rice. It is located at Las Vegas Hot Springs, 6 miles above Las Vegas, N. Mex. There are 4 bridges about a quarter mile below the station, but it is impossible to establish a station on any of them for the reason that it would be within the backwater of a dam a quarter mile farther down. There is an adjustable ice dam with a 12-foot fall about 200 feet above the station, but it has no effect upon the measurements. The original gage was a vertical 1 by 8 inch pine board, 10 feet long and graduated to feet and tenths. It was bolted to the masonry wall on the right bank, which protects Hot Springs Nos. 16 and 17. This gage was washed out by the flood of September 29, 1904, and was replaced by a similar rod of 1 by 5 inch pine, by G. B. Monk on October 19, 1904. The new rod is 0.71 foot lower than the old one. All gage heights after September 29, 1904, have been reduced 0.70 foot to make them correspond with the readings on the original gage. The gage is read once each day by William Prager, except when rapid fluctuations make more frequent observations advisable. Discharge measurements are made at low water by wading 600 feet above the gage and at high water from one of the bridges. The initial point for soundings is a cross cut in the rock on the left bank 600 feet above the gage. The channel is straight for

about 200 feet above and 400 feet below the station. The current is swift. The bed and banks of the stream are of solid rock. The banks are high and not liable to overflow. There is but one channel at all stages. There are two bench marks at this station. Bench mark No. 1 is a bolt leaded into the rock on the left bank, 200 feet above the gage and 400 feet below the station; elevation, 19.17 feet above the zero of the new gage. Bench mark No. 2 is the top of the center stone of hot springs No. 17; elevation, 20.23 feet above the zero of the new gage.

This station was established for the purpose of determining the amount of water available for storage in the Sanguyjuella basin, about 6 miles northwest of Las Vegas, N. Mex. The observations during 1904 have been made under the direction of Mr. M. C. Hinderlider, district hydrographer. Owing to the extreme low stage of the river prior to the flood of September 29, 1904, it was impracticable to obtain any discharge measurements.

Discharge measurements of Gallinas River near Las Vegas, N. Mex., in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
August 13	E. G. Marsh	.....	1.85	1.59	0.50	2.9
1904.						
October 11[b]	G. B. Monk	43	54	2.50	1.60	135

[a] Gage heights refer to original gage.

[b] Measured from foot bridge.

Mean daily gage height,[a] in feet, of Gallinas River near Las Vegas, N. Mex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.20	0.35	0.60	0.20	0.20	0.20	0.60	0.65	0.60	.....	1.20	1.00
2	.20	.20	.50	.20	.20	.20	.30	.80	.50	.....	1.25	.90
3	.20	.20	.50	.20	.20	.20	.20	.65	.40	.....	1.15	.90
4	.20	.20	.25	.20	.25	.20	.20	.50	.30	.....	1.05	.90
5	.15	.20	.20	.20	.20	.20	.20	.85	.30	.....	1.00	.95
6	.10	.20	.20	.20	.20	.20	.20	.85	.30	.....	1.05	1.00
7	.10	.20	.20	.20	.20	.20	.35	1.00	.30	.....	1.10	1.00
8	.10	.20	.35	.20	.20	.20	.25	.80	.20	1.80	1.10	.90
9	.10	.20	.40	.20	.20	.20	.20	.50	.20	2.10	1.10	1.05
10	.10	.20	.25	.20	.20	.20	.20	.50	.20	1.90	1.05	1.05
11	.10	.20	.40	.20	.20	.25	.20	.40	.20	1.50	1.05	1.10
12	.10	.20	.40	.20	.20	.25	.20	.40	.20	1.30	1.10	1.10
13	.10	.20	.40	.20	.20	.30	.20	.45	.20	1.20	1.10	1.10
14	.10	.20	.30	.20	.20	.20	.20	.50	.15	1.05	1.20	1.10
15	.10	.20	.30	.20	.20	.30	.20	.50	.10	.90	1.10	1.10
16	.10	.20	.30	.20	.20	.20	.20	.40	.10	.90	.95	1.10
17	.10	.20	.30	.20	.20	.20	.20	.50	.10	.90	1.05	1.15
18	.10	.20	.30	.20	.20	.20	.57	1.98	.10	.95	1.10	1.10
19	.15	.20	.30	.20	.20	.20	.20	.75	.10	.95	1.10	1.10
20	.20	.20	.30	.20	.20	.20	.25	.55	.10	1.00	1.10	1.10
21	.20	.20	.30	.20	.20	.20	.20	.40	.10	1.00	1.10	1.10
22	.20	.20	.20	.20	.20	.20	.20	.40	.10	1.00	1.10	1.10
23	.20	.20	.20	.20	.20	.20	.75	.45	.10	1.10	1.10	1.10
24	.20	.20	.20	.20	.20	.20	.60	.40	.10	1.10	1.05	1.10
25	.20	.20	.20	.20	.20	.20	.65	.30	.10	1.10	1.20	1.10
26	.20	.60	.20	.20	.20	.20	.65	1.12	.10	1.20	1.10	1.10
27	.20	.40	.20	.20	.20	.30	.75	1.00	.10	1.20	1.15	1.10
28	.20	.40	.20	.20	.20	.25	1.00	.85	1.25	1.20	1.10	1.10
29	.20	.70	.20	.20	.20	.20	.60	.75	.....	1.20	1.00	1.10
30	.20	.....	.20	.20	.20	.20	.50	.70	.....	1.20	1.50	1.15
31	.20	.....	.20	.....	.20	.....	.65	.60	.....	1.20	.....	1.20

[a] All gage heights refer to original gage.

HONDO RIVER AT ROSWELL, N. MEX.

This station was established April 25, 1903, by W. M. Reed. It is located at the bridge at the intersection of Main and Vegas streets, Roswell, N. Mex. The gage is a 4 by 4 inch inclined timber set on the right bank 150 feet below the bridge. It is read by members of the Geological Survey office force at Roswell. Discharge measurements are made from the highway bridge. The initial point for soundings is a zero marked on the east stringer at the north end of the bridge. The channel is nearly straight for 50 feet above and 450 feet below the bridge and has a width at ordinary high stages of 40 feet. The current has a moderate velocity. Both banks are low and overgrown with weeds, but are not liable to overflow. The bed of the stream is sandy loam, fairly permanent, and free from vegetation. There is but one channel at all stages. The bench mark is the initial point for soundings. Its elevation is 8.50 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. M. Reed, district hydrographer.

Discharge measurements of Hondo River at Roswell, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
May 28	F. Dobson	14	7	0.40	0.53	2.8
July 3	do	25	65	2.55	2.80	167
September 28	do	31	61	3.23	3.60	196
September 28	do	22	24	2.57	2.30	61
September 28	do	22	39	3.12	2.95	121
September 29	do	32	112	3.71	4.50	415
October 1	do	26	74	3.46	3.85	257
October 10	do	29	85	3.95	4.20	336
November 2	do	12	10.8	1.27	.90	13.7

Mean daily gage height, in feet, of Hondo River at Roswell, N. Mex., for 1904.

Day.	May.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	July.	Aug.	Sept.	Oct.	Nov.
1					3.90	0.70	17					1.75	
2			0.30		3.25	.60	18		0.15			1.75	
3		1.78	.30	1.40	2.55	.60	19		1.50			1.70	
4		.80	1.30		2.40	.60	20		1.05			1.60	
5			1.20		2.20	.60	21		.00			1.60	
6			1.35		2.15	.65	22		1.25			1.60	
7			3.05		2.65	.70	23		1.60			1.50	
8			.50		4.60	.80	24					1.50	
9			.50		4.80	.90	25					1.40	
10			2.95		4.35	.90	26					.90	
11			1.25		4.50	.90	27	0.39				.90	
12					3.25	.90	28	.27			2.25	1.00	
13					2.70	.90	29				3.15	1.00	
14				.85	2.10	.70	30				4.30	.90	
15					1.90	.70	31					.85	
16					1.75	.65							

NOTE.—River dry during 1904 on days for which no gage height is given.

HONDO RIVER AT HONDO RESERVOIR SITE, NEW MEXICO.

This station was established March 9, 1903, by W. A. Wilson. It is located at the first New Mexico reservoir dam site, 12 miles southwest of Roswell, N. Mex. A footbridge has been constructed 75 feet below the dam for the purpose of making discharge measurements. The gage is a 4 by 4 inch inclined timber which is located 10 feet north of this bridge. The gage is read twice each day by Lee Hall. The initial point for soundings is 1 foot south of the north end of the west stringer of the bridge. The channel is straight for 200 feet above and

below the station. The current is swift at high water and sluggish at low water. Both banks are high, without trees, and not liable to overflow. There is but one channel at all stages. The bed is composed of shifting sand, and the cross section changes during each flood. Bench mark No. 1 is the upper surface of the crosspiece which supports the stringer at the north end of the bridge. Its elevation is 8.50 feet above the zero of the gage. Bench mark No. 2 is on a ledge of rock which bears S. 45° W. and is 650 feet distant from the gage. Its elevation is 19.10 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. M. Reed, district hydrographer.

Discharge measurements of Hondo River at Hondo reservoir site, New Mexico, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
July 4	F. Dobson	27	12	3.07	1.90	37
July 19	W. A. Wilson	26	107	5.35	7.10	573
July 19	do	28	135	5.33	7.75	720
August 10	do	23	43	3.19	2.90	137
September 3	F. Dobson	18	17	2.99	2.40	50
September 23	do	22	24	2.57	2.30	61
October 11[a]	do	118	622	10.16	10.64	6,322
November 11	do	12	7.6	2.50	1.00	19

[a] Computed by Kutter's formula.

Mean daily gage height, in feet, of Hondo River at Hondo reservoir site, New Mexico, for 1904.

Day.	Jan.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.80	.....	.....	.....	.....	10.05	1.20	0.95
2	.70	.....	1.20	2.10	.....	1.80	1.20	.90
3	.80	.....	5.10	4.25	5.60	1.15	1.20	.90
4	.90	.....	1.95	2.90	1.45	1.00	1.15	.90
5	1.00	.....	1.60	3.60	1.65	.70	1.10	1.35
6	1.10	.....	1.45	5.05	1.40	.35	1.10	.90
7	1.10	.....	.60	2.80	.60	3.05	1.10	.95
8	1.00	.....	.....	2.50	.....	[a]9.90	1.05	.90
9	.80	.....	.....	5.45	.....	8.05	1.00	.90
10	.70	.....	.....	4.05	.....	7.80	1.00	1.00
11	.70	.....	.....	2.60	.....	5.20	1.00	.95
12	.60	.....	.....	2.35	.....	4.00	1.10	.90
13	.50	.....	.....	1.80	.....	3.35	1.05	.90
14	.30	.....	.....	1.60	1.20	2.90	1.05	.95
15	.10	.....	.....	1.60	.....	2.55	.95	1.05
16	.....	.....	.....	1.60	.....	2.25	1.00	.95
17	.....	.....	1.50	1.55	.....	2.00	1.00	1.05
18	.50	.....	1.55	1.35	.....	1.75	1.00	1.00
19	.30	.....	5.70	.60	.....	1.55	.95	1.00
20	.....	.....	2.25	1.00	.....	1.50	.95	1.00
21	.....	0.30	1.80	1.55	.....	1.45	.95	1.00
22	.....	1.10	2.95	.60	.....	1.40	1.00	.95
23	.....	1.30	3.20	1.70	.....	1.35	1.00	.90
24	.....	.60	2.00	2.90	2.60	1.30	.95	.95
25	.20	.....	1.85	2.40	2.60	1.30	1.00	.90
26	.....	.....	1.65	2.10	1.45	1.30	1.00	.90
27	.....	.....	1.50	1.45	1.15	1.25	.95	[b]1.70
28	.....	.....	1.40	.65	5.50	1.20	1.00	[b]1.35
29	.....	.50	1.45	.....	2.30	1.15	1.00	[b]1.50
30	.....	.....	.65	.60	[a]9.60	1.15	.95	[b]1.35
31	.15	.....	.....	.....	.....	1.25	.....	[b]1.20

[a] River over its banks. [b] Ice conditions.

NOTE.—Dry during 1904 on days for which no gage height is given.

TOYAH CREEK AT TOYAHVALE, TEX.

Toyah Creek is located in trans-Pecos, Texas, in Reeves County, and is fully described in Water-Supply Paper No. 105. It rises in a large spring 40 miles southwest of Pecos, Tex., and the water is used both for irrigation and power purposes, the power plants being a result of the irrigation as they are located upon the irrigation ditches.

About 100 yards north of Toyah Spring, on the land of C. W. Giffin, are two other springs (that derive their waters from a similar underground source), with a combined discharge of 8 second-feet. The location of these springs in arid Texas makes their waters very valuable, and they have been utilized in the excellent irrigation systems that are fully described in Water-Supply Papers Nos. 71 and 105.

The discharge of the main spring has been measured as follows:

Discharge measurements of Toyah Creek at Toyahvale, Tex., 1900 and 1904.

Date.	Hydrographer.	Discharge.
		Second-feet.
September 5, 1900	T. U. Taylor	46
July 21, 1904	do	46

SANTA ROSA SPRING NEAR FORT STOCKTON, TEX.

Santa Rosa Spring is 9 miles from Grand Falls and 28 miles north of Fort Stockton. It rises suddenly in the mesquite prairie and is carried off in ditches to the irrigated farms of Ray and Scott, near the post-office of Santa Lucia. The discharge of the spring, as measured on July 27, 1904, at the irrigation ditch at Santa Lucia, was 4 second-feet.

COMANCHE CREEK NEAR FORT STOCKTON, TEX.

Comanche Creek is located in Pecos County and has its source at the town of Fort Stockton, and this creek has long been a factor in the civilization of western Texas. It was here where one of the first United States Government forts was established, on account of the excellent water. The oldest irrigation systems in trans-Pecos, Texas, away from the Rio Grande are located here. The waters of this creek are used both for irrigation and power, the power plant being located upon the irrigation ditches.

Discharge measurements have been made as follows:

Discharge measurements of Comanche Creek near Fort Stockton, Tex., 1899 and 1904.

Date.	Hydrographer.	Discharge.
		Second-feet.
Summer, 1899	T. U. Taylor	66
July 26, 1904	do	64

DEVILS RIVER AT DEVILSRIVER, TEXAS.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is opposite the Southern Pacific Railway station at Devilsriver. The river is about 50 miles in length, has a perennial flow, and during flood periods is subject to great fluctuations.

The observations at this station during 1904 have been made under the direction of International (Water) Boundary Commission.

Discharge measurements of Devils River at Devilsriver, Tex., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 6	J. D. Dillard	450	1.18	2.3	529
January 11	do	441	1.22	2.3	537
January 17	do	450	1.21	2.3	546
January 27	do	449	1.21	2.3	542
February 5	do	442	1.20	2.3	529
February 15	do	446	1.15	2.3	513
February 21	do	449	1.15	2.3	517
February 26	do	438	1.18	2.3	516
March 7	do	440	1.11	2.25	488
March 17	do	447	1.15	2.3	512
March 23	do	447	1.14	2.3	511
March 30	do	438	1.12	2.25	490
April 4	do	449	1.17	2.35	526
April 12[a]	do	429	1.14	2.25	491
April 22	do	664	2.68	3.7	1,777
April 27	do	286	1.56	2.25	445
May 6	do	317	1.54	2.25	489
May 11	do	318	1.53	2.25	485
May 16	do	361	1.64	2.4	593
May 23	do	336	1.55	2.3	520
May 27	do	334	1.52	2.3	509
June 1	do	316	1.49	2.25	472
June 6	do	590	2.31	3.25	1,361
June 11	do	389	1.69	2.6	656
June 20	do	339	1.57	2.4	532
June 27	do	325	1.52	2.3	495
July 5	E. E. Winter	369	1.39	2.3	512
July 11	do	356	1.27	2.3	451
July 22	do	351	1.17	2.25	412
July 25	do	361	1.35	2.3	488
July 29	do	362	1.33	2.3	482
August 3	do	352	1.39	2.25	489
August 12	do	347	1.39	2.25	483
August 16	do	342	1.41	2.25	481
August 22	do	345	1.29	2.25	444
August 29	do	344	1.26	2.25	432
September 9	do	647	2.23	3.3	1,443
September 20	do	425	1.32	2.5	563
October 4	do	422	1.44	2.5	609

[a] On April 17 the cable at this station was moved 150 feet downstream. The old gage is still used.

Discharge measurements of Devils River at Devilsriver, Tex., in 1904.—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
October 6	E. E. Winter	363	1.48	2.4	538
October 24	do	411	1.45	2.5	596
November 4	do	374	1.35	2.4	504
November 12	do	376	1.36	2.4	513
November 23	do	377	1.32	2.4	499
November 27	do	352	1.29	2.35	454
December 2	do	357	1.34	2.35	478
December 14	do	364	1.34	2.3	489
December 22	do	344	1.30	2.3	446
December 30	do	345	1.28	2.3	443

Mean daily gage height, in feet, of Devils River at Devilsriver, Tex., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.3	2.3	2.3	2.3	2.25	2.3	2.25	2.25	2.5	2.4	2.35
2	2.3	2.3	2.3	2.3	2.25	2.25	2.3	2.25	2.25	2.5	2.4	2.35
3	2.3	2.3	2.25	2.35	2.3	2.25	2.3	2.25	2.25	2.5	2.4	2.35
4	2.3	2.3	2.25	2.35	2.3	2.25	2.3	2.25	2.3	2.5	2.4	2.3
5	2.3	2.3	2.25	2.35	2.25	2.8	2.3	2.25	2.3	2.5	2.4	2.3
6	2.3	2.3	2.25	2.3	2.25	3.2	2.3	2.25	2.35	2.45	2.4	2.3
7	2.3	2.3	2.25	2.3	2.25	2.6	2.3	2.25	2.5	2.5	2.4	2.3
8	2.3	2.3	2.25	2.3	2.25	2.45	2.3	2.25	2.85	2.5	2.4	2.3
9	2.3	2.3	2.25	2.3	2.25	2.45	2.3	2.25	3.0	2.5	2.4	2.3
10	2.3	2.3	2.3	2.25	2.25	2.45	2.3	2.25	2.8	2.5	2.4	2.3
11	2.3	2.3	2.3	2.25	2.25	2.7	2.3	2.25	2.5	2.5	2.4	2.3
12	2.3	2.3	2.3	2.25	2.25	2.7	2.3	2.25	2.55	2.5	2.4	2.3
13	2.3	2.3	2.3	2.25	2.25	2.6	2.3	2.25	2.35	2.5	2.4	2.3
14	2.3	2.3	2.3	2.25	2.5	2.5	2.3	2.25	2.3	2.5	2.4	2.3
15	2.3	2.3	2.3	2.25	2.5	2.5	2.3	2.25	2.3	2.5	2.4	2.3
16	2.3	2.3	2.3	2.25	2.45	2.4	2.3	2.25	2.3	2.45	2.4	2.3
17	2.3	2.3	2.3	2.25	2.4	2.4	2.25	2.25	2.3	2.4	2.4	2.3
18	2.3	2.3	2.3	2.25	2.3	2.4	2.25	2.25	2.5	2.4	2.4	2.3
19	2.3	2.3	2.3	2.25	2.3	2.4	2.25	2.25	2.5	2.4	2.4	2.3
20	2.3	2.3	2.3	2.25	2.3	2.4	2.25	2.25	2.5	2.4	2.4	2.3
21	2.3	2.3	2.3	2.25	2.3	2.4	2.25	2.25	2.5	2.4	2.4	2.3
22	2.3	2.3	2.3	3.4	2.3	2.4	2.25	2.25	2.75	2.4	2.4	2.3
23	2.3	2.3	2.3	2.35	2.3	2.35	2.25	2.25	2.95	2.5	2.4	2.3
24	2.3	2.3	2.3	2.25	2.25	2.35	3.2	2.25	2.5	2.5	2.35	2.3
25	2.3	2.3	2.3	2.25	2.25	2.35	2.3	2.25	2.5	2.4	2.35	2.3
26	2.3	2.3	2.3	2.25	2.25	2.3	2.25	2.25	2.5	2.4	2.35	2.3
27	2.3	2.3	2.25	2.25	2.3	2.3	2.25	2.25	2.5	2.4	2.35	2.3
28	2.3	2.3	2.25	2.25	2.3	2.3	2.25	2.25	2.5	2.4	2.35	2.3
29	2.3	2.3	2.25	2.25	2.35	2.3	2.25	2.25	2.5	2.4	2.35	2.3
30	2.3	.....	2.25	2.25	2.35	2.3	2.25	2.25	2.5	2.4	2.35	2.3
31	2.3	.....	2.25	.....	2.3	.....	2.25	2.25	.....	2.4	.....	2.3

Mean daily discharge, in second-feet, of Devils River at Devilsriver, Texas, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	530	535	515	510	470	a 470	500	450	430	590	520	470
2	530	535	510	510	460	470	500	470	430	600	515	a 480
3	530	530	490	525	490	470	510	a 490	430	610	510	480
4	530	530	490	a 525	500	470	510	490	480	a 610	a 505	440
5	530	a 530	490	525	480	800	a 510	490	480	610	505	445
6	a 530	530	490	510	a 490	a 1,300	500	490	505	a 575	505	450
7	530	525	a 490	510	490	655	490	490	620	610	510	455
8	535	525	490	510	490	560	480	485	970	610	510	460
9	535	525	490	510	485	560	470	485	a 1,120	610	510	465
10	535	520	510	490	485	560	460	485	910	610	510	470
11	a 535	520	510	490	a 485	a 730	a 450	485	600	600	510	475
12	535	520	510	a 490	485	730	450	a 485	650	600	a 510	480
13	535	515	510	490	485	655	450	480	480	600	510	485
14	540	515	510	490	680	590	450	480	440	600	510	a 490
15	540	a 515	510	490	680	590	450	480	440	600	510	480
16	545	515	515	490	a 630	580	450	a 480	440	570	505	475
17	a 545	515	a 515	490	595	580	410	470	440	530	505	470
18	545	515	515	490	530	580	410	465	560	530	505	465
19	545	515	515	490	520	580	410	460	560	530	505	460
20	545	515	510	490	520	a 580	410	455	a 565	530	500	455
21	545	a 515	510	490	520	580	410	450	570	530	500	450
22	545	515	510	a 1,580	520	530	a 410	a 445	770	530	500	a 445
23	545	515	a 510	490	a 520	510	410	445	930	595	a 500	445
24	545	515	510	445	480	510	1,200	440	580	a 595	460	445
25	545	515	510	445	480	510	a 490	440	580	530	460	445
26	540	a 515	510	445	480	495	450	440	580	530	460	445
27	a 540	515	490	a 445	a 510	a 495	450	435	580	530	a 455	445
28	540	515	490	445	510	495	440	435	580	530	455	445
29	540	515	490	445	560	495	a 440	a 430	580	530	450	445
30	540	.....	a 490	445	560	495	440	430	580	530	450	a 445
31	540	.....	490	.....	510	.....	440	430	.....	530	.....	445

a Meter measurements.

Estimated monthly discharge of Devils River at Devilsriver, Texas, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	545	530	538	33,104
February	535	515	520	29,911
March	515	490	503	30,932
April	1,580	445	523	31,140
May	680	460	519	31,934
June	1,300	470	578	34,364
July	1,200	410	479	29,455
August	490	430	464	28,532
September	1,120	430	596	35,464
October	610	530	570	35,078
November	520	450	495	29,474
December	490	440	460	28,264
The year	1,580	410	520	377,652

SAN FELIPE CREEK AT DELRIO, TEX.

San Felipe Creek rises in four large springs northeast of Delrio, Tex., and flows south into the Rio Grande. The waters of these springs are used in two large irrigation systems, the one on the west side of the creek having been in use for many years, while the one to the east has recently been constructed by G. Bedell Moore. The following table shows the discharge measurements that have been taken on the combined flow of Madre ditch and the creek just south of the railroad bridge of the Southern Pacific Railway.

Discharge measurements of San Felipe Creek at Delrio, Tex., 1895–1904.

Date.	Hydrographer.	Discharge.
		Second-feet.
December, 1895	C. C. Babb	99
March, 1899	T. U. Taylor	113
September, 1900	do	[a] 149
December, 1901	C. N. Campbell	[b] 150
September, 1902	T. U. Taylor	115
March, 1904	do	[c] 118

[a] Rainy season. [b] After Brackett flood. [c] Includes 38 second-feet in ditch.

LAS MORAS CREEK NEAR BRACKETTVILLE, TEX.

Las Moras, like its sister springs of the Edwards Plateau, rises very suddenly. It is located near the twin towns of Brackettville and Fort Clark, and threads its way between the two. It flows south, supporting many irrigation systems, and finally empties into the Rio Grande 25 miles above Eagle Pass. Its flow is very variable, being a reflex barometer of the season preceding, and, like the Leona at Uvalde, it gives a safe index of the rainfall on the Edwards Plateau for the months before. The following table shows the discharge measurements that have been taken:

Discharge measurements of Las Moras Creek near Brackettville, Tex., 1895–1904.

Date.	Hydrographer.	Discharge.
		Second-feet.
December, 1895	C. C. Babb	[a] 21
June, 1899	T. U. Taylor	[b] 60
September, 1900	do	[b] 51
September, 1902	do	[b] 11
September, 1902	do	[b] 11
March, 1904	do	[b] 28

[a] At footbridge, Brackett. [b] Milligans Bend.

Discharge of the big springs of Texas.

Stream.[a]	Minimum discharge in second-feet.	Location.
Bartons Springs	20	Austin.
Clear Creek	15	Menard County.
Comanche Creek	65	Fort Stockton.
Comal River	320	Comal County.
Devils River	380	Valverde County.
Kickapoo Spring	4	Tom Green County.
Lampasas River	10	Lampasas.
Las Moras Creek	11	Brackettville.
Leona River	0	Uvalde.
Lipan Spring	1	Tom Green County.
Mill Creek	10	San Saba.
Mormon Springs	4	Austin.
Salado Creek	13	Bell County.
San Antonio River	10	San Antonio (hot wells).
San Felipe Creek	90	Delrio.
San Marcos Creek	150	San Marcos.
San Pedro Creek	9	San Antonio.
Santa Rosa Spring	4	Santa Lucia.
San Saba River	15	Fort McKavett.
Toyah Creek	46	Toyahvale.

[a] Stream leading from spring.

MISCELLANEOUS MEASUREMENTS IN RIO GRANDE DRAINAGE BASIN.

Discharge measurements at miscellaneous stations.

Stream.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
	1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-ft.*
Rio Grande canal 200 feet above head-gate.	May 16	G. B. Monk	66	100	4.71	1.70	471
Rio Grande at Monte Vista.	May 24	do	157	389	1.35	1.60	525
Rio Grande Valley ditch 5 miles northwest of Monte Vista.	do	do	14	16	4.00		64
Rio Grande at Monte Vista.	July 14	do	105	134	.58	.50	77
Rio Grande at San Marcial.	July 25	do	155	138	2.11	7.80	291
Rio Grande at Monte Vista.	July 30	do	44	40	2.05	.60	82
Rio Grande at Albuquerque	Oct. 22	do	102	600	3.75		2,252
Rio Grande at San Marcial.	Nov. 3	do	159	268	4.92	8.10	1,318

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[Water-Supply Paper No. 132.]

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1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL
BY
M. C. HINDERLIDER, G. L. SWENDSEN, and A. E. CHANDLER

PART X.—Colorado River and The Great Basin Drainage

WASHINGTON
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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., April 14, 1905.

SIR: I transmit herewith the manuscript of Part X of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of Messrs. M. C. Hinderlider, G. L. Swendsen, and A. E. Chandler. Mr. Hinderlider had charge of the operations in Colorado and eastern Utah. He was assisted by R. I. Meeker and Howard S. Reed. Mr. Swendsen had charge of the work in the vicinity of Great Salt Lake, and was assisted by W. D. Beers, Caleb Tanner, and W. G. Swendsen. Mr. Chandler carried on the investigations in Nevada, and was assisted by W. A. Wolfe and J. T. Shaw. A limited amount of the data submitted herewith was collected under the direction of other hydrographers, as noted in the list of acknowledgments. The assembling of the data and the preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, and A. H. Horton.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART X.

By M. C. HINDERLIDER, G. L. SWENDSEN, and A. E. CHANDLER.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning, and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid section." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	20,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

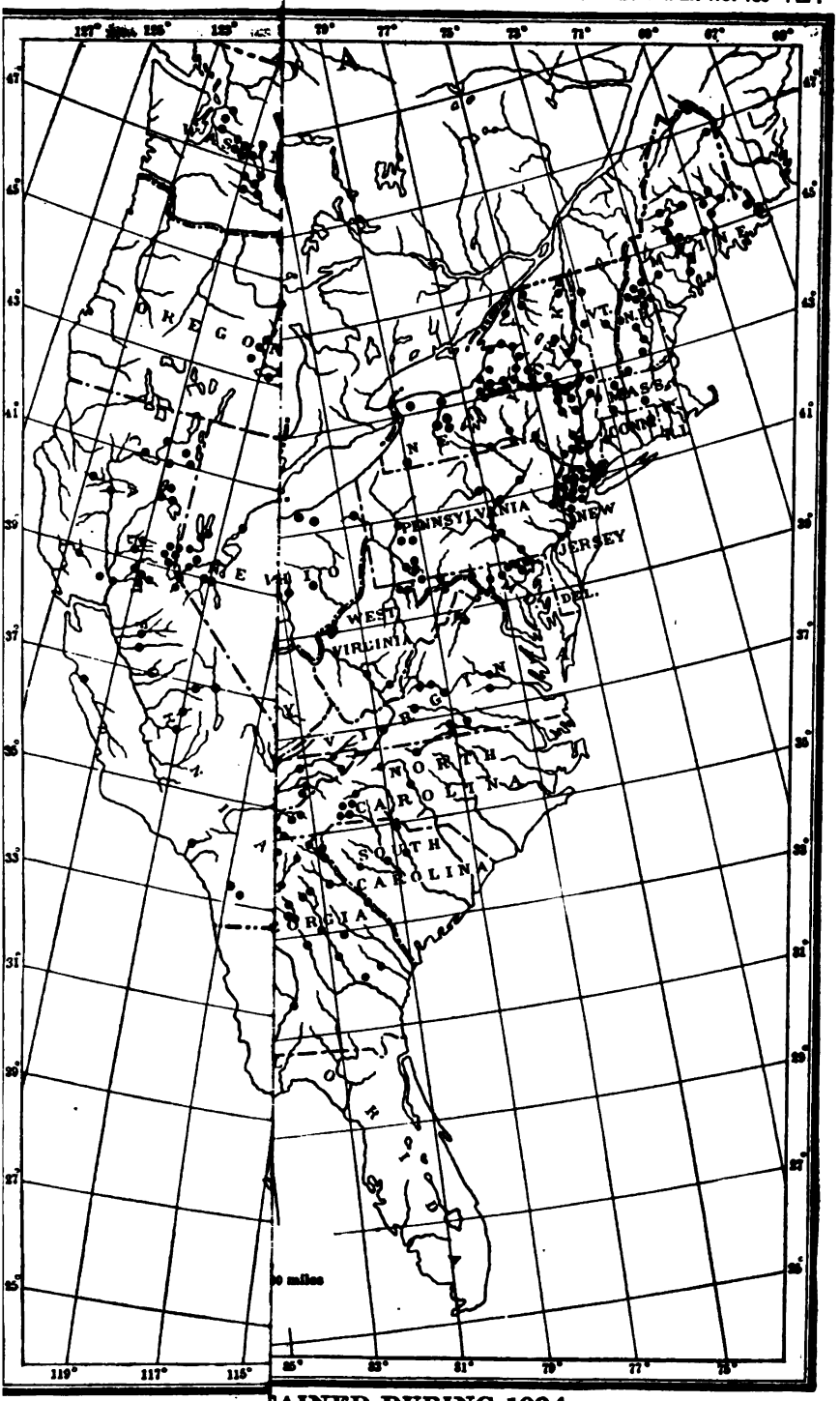
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage readings. From these two factors it is possible to estimate both the total flow and its distribution through the period of observations.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations; and second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station with car, tag-line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tagged line indicating the points of measurement. Where the current is swift some appli-



MAINED DURING 1904.

ance—generally a secondary cable—is necessary to hold the meter in position below the surface.

Gaging stations are generally located at bridges if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. Great care is taken in the selection and equipment of gaging stations, in order that the data may have the required degree of accuracy.

On many of the larger rivers where water power is developed by dams estimates of flow are obtained by observing the head on the crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

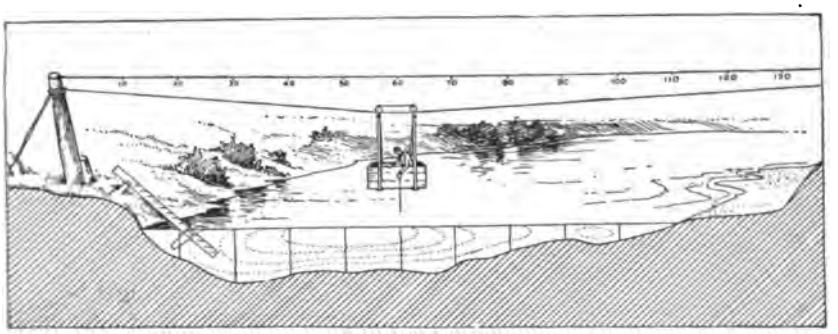


FIG. 1.—Cable station, showing section of river, car, gage, etc.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points are usually at regular intervals varying from 2 to 20 feet, depending

upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities, and soundings are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth, for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between 0.94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from 0.85 to 0.95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity-curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity-curve and the initial line. Owing to the length of time it takes to make these measurements, they are seldom used except for determining coefficients for purposes of comparison, and for measurements under ice.

PRICE CURRENT METERS, WITH BUZZERS.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity, twice the mid-depth velocity, and the bottom velocity, by 4.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square-mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot: 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area on the assumption that the run-off is uniformly distributed

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily gage heights and the daily discharge of a stream are the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights. (2 and 3 depend on 1.)

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds, the results of the discharge measurements are plotted on cross-section paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared. The mean velocity and area determined for each discharge measurement are also platted. Through these points the curves of mean

velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value in determining the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station-rating curve, the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character, the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made, the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes occur.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are taken either by integration in verticals or by the vertical-velocity curve method, as sufficient experiments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part X, is published in a series of twelve

Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainages.
Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.
Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.
Part 5. Eastern Mississippi River drainage.
Part 6. Great Lakes and St. Lawrence River drainage.
Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.
Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.
Part 9. Western Gulf of Mexico drainage.
Part 10. Colorado River and the Great Basin drainage.
Part 11. The Great Basin and Pacific Ocean drainage in California.
Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations and such other information that has been collected that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns which are defined on pages 15-16 are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should, in general, be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications. A detailed index of these reports (from 1888–1903) is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-Second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Arizona.—District hydrographers, C. G. Williams and W. A. Farish,[a] assisted by W. Richins, O. Richins, R. H. Ross, and H. R. Fry.

California.—The hydrographic work of the United States Geological Survey in California has been carried on in cooperation with the State, in accordance with an act of the State legislature approved March 16, 1903, which is in substance as follows:

"The State board of examiners are hereby empowered to enter into contracts with the Director of the United States Geological Survey for the purpose of making topographic maps to the extent of twenty thousand dollars; also for the purpose of gaging streams, surveying reservoir sites and canal locations, for the conservation and utilization of the flood or storm waters of the State to the extent of fifteen thousand dollars," etc.

The State board of examiners is composed of the following members, viz: George C. Pardee, governor; C. F. Curry, secretary of State; U. S. Webb, attorney-general; Walter S. Mellick, secretary.

Although the portion of the bill referring to hydrographic work provides for making surveys of reservoir sites and canal locations none of the State money has been expended for this purpose; the Geological Survey has made these investigations on Putah Creek, Sacramento River, Pit River and tributaries, Owens River, and Colorado River, and has paid the entire expense from its own funds.

The State appropriation, $7,500 of which became available July 1, 1903, has been used exclusively for gathering general stream-flow data; the Survey also apportioned $10,400 for the same purpose for the fiscal year beginning July 1, 1903. At this time 28 gaging stations were being maintained in California; other stations were added, and on December 31, 1903, 56 stations were being maintained. The data being accumulated for each of these stations has a specific value in connection with the future development of the resources of the State. The information will be invaluable in designing and making estimates of cost for storage, irrigation, power, and drainage works, and for use in litigation.

The work in the western and southern portions of California was under the direction of the supervising engineer, J. B. Lippincott,[b] assisted by hydrographers Samuel G. Bennett and W. B. Clapp. Acknowledgments are also due to the following individuals and corporations for assistance rendered and data furnished: To the Kern County Land Company, through A. K. Warren, engineer in charge of water measurements, for the record of Kern River; to the city of Santa Barbara for cooperation in gaging Santa Ynez River and Mono Creek; to the Southern Pacific Railway Company through its chief engineer, William Hood, for river stage records of San Joaquin River at Herndon, Cal., and King River at Kingsburg, and for transportation furnished supervising engineer and assistants; and to the officials of the Santa Fe Route for transportation furnished to the supervising engineer and assistants.

The work in the extreme eastern portion of California was carried on under the direction of L. H. Taylor,[c] engineer, United States Geological Survey, and A. E. Chandler, State engineer of Nevada, assisted by W. A. Wolf, J. T. Shaw, R. A. Craig, O. F. Heizer, and L. A. Woolley. Acknowledgment is due to the Southern Pacific Railway Company, for transportation furnished the district hydrographers and assistants.

Colorado.—District and resident hydrographer, M. C. Hinderlider;[d] assisted by R. I. Meeker, assistant engineer; Oro McDermith, William A. Lamb, George B. Monk, L. E. Foster, hydrographers; and Melvin Beeson, Thomas E. Brick, Theodore Tobish, and F. L. Meeker, office assistants. Acknowledgments are due the Denver and Rio Grande; Colorado and Southern; Burlington and Missouri River;

[a] Office, Phoenix, Arizona.
[b] Office, 1108 Braly Building, Los Angeles, California.
[c] Office, Hazen, Nevada.
[d] Office, Chamber of Commerce Building, Denver, Colorado.

Union Pacific; Rio Grande Southern; and Atchison, Topeka and Santa Fe railroads for free transportation for hydrographers over their lines.

Idaho.—District engineer, D. W. Ross,[a] assisted by Fred Stockton, William G. Davies, and J. B. Bond.

Nevada.—The hydrographic work in this section has been carried on in cooperation with the State by L. H. Taylor,[b] engineer, United States Geological Survey, and A. E. Chandler, State engineer, assisted by W. A. Wolf, J. T. Shaw, R. A. Craig, O. F. Heizer, H. H. Church, and L. A. Woolley. Acknowledgment is due to the Southern Pacific Railway Company for transportation furnished the district hydrographers and assistants and also to the San Pedro, Los Angeles and Salt Lake Railroad Company for transportation furnished the State engineer.

New Mexico.—The hydrographic work in the northern portion of this Territory was carried on under the direction of the district hydrographer, M. C. Hinderlider, assisted as follows: The work in the north-central portion was in charge of George B. Monk; that in the extreme eastern portion was in charge of W. G. Russell; while the work in the northwestern portion was in charge of Robert C. Prewitt. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River, acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of Lacueva, N. Mex.; also to James D. Hand, of Las Alamos, N. Mex., for similar favors. Transportation in the form of an annual pass was furnished George B. Monk by the Denver and Rio Grande Railroad, and to W. G. Russell by the Chicago, Rock Island and El Paso Railroad. For the purpose of collecting data in New Mexico during the latter part of the year an annual pass over the Atchison, Topeka and Santa Fe Railroad was issued to George B. Monk, for which acknowledgments are due.

Oregon.—District engineer, John T. Whistler,[d] assisted by John H. Lewis during the first quarter, and by Wilbur C. Sawyer, Edwards N. Smith, and Ivan Landes the remainder of the year. Acknowledgment and thanks are due the Oregon Railroad and Navigation Company; Southern Pacific Railway Company; Oregon Short Line Railroad Company; Sumpter Valley Railway; and the Columbia Southern Railway for transportation; to the Pacific Live Stock Company, through Mr. Gilchrist, superintendent, for gratuitous gage readings; and to W. C. McDonald for the use of his ferry cable on John Day River as a gaging station.

Utah.—District engineer, George L. Swendsen,[e] assisted by W. D. Beers, Caleb Tanner, W. G. Swendsen, Henry S. Kleinschmidt, and Horace W. Sheley. Acknowledgments are also due to the Oregon Short Line; Denver and Rio Grande; and San Pedro, Los Angeles and Salt Lake railway companies for transportation; to the Telluride Power Company, Logan River canal companies, Jordan River canal companies, Salt Lake engineer, J. Fewson Smith, jr., water commissioner for Jordon Valley, William Knight, superintendent of pumping plant at Utah Lake, and others who have given assistance from time to time. All daily papers of the State have supported the work strongly, and have done much to emphasize the importance of hydrographic information to a proper development of irrigation interests.

The hydrographic work in the Uinta Indian Reserve has been carried on under the direction of the district hydrographer, M. C. Hinderlider, by the resident hydrographer, Howard S. Reed.

Wyoming.—The hydrographic work in this State has been carried on under the direction of the district hydrographer, M. C. Hinderlider,[c] by the resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming, to the Union Pacific; Chicago, Burlington and Quincy; Colorado and Southern; Colorado and Wyoming; and Fremont, Elkhorn and Missouri River Valley railroads.

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[a] Office, Boise, Idaho.
[b] Office, Hazen, Nevada.
[c] Office, Chamber of Commerce Building, Denver, Colorado.
[d] Office, Pendleton, Oregon.
[e] Office, Salt Lake, Utah.

COLORADO RIVER DRAINAGE BASIN.

Colorado River is formed by Grand and Green rivers in the northeastern part of Utah. It flows in a southerly direction, passing into Arizona, from whence it flows westerly to the Nevada State line. From here it continues in a southerly direction, forming the boundary between Arizona, California, and Nevada. At Yuma it enters Old Mexico, and a few miles below empties into the northern extremity of the Gulf of California.

The drainage area of Colorado River, which is 225,000 square miles above Yuma, Ariz., comprises the southwest part of Wyoming, the western part of Colorado, the eastern half of Utah, practically all of Arizona, and a small portion of California and Nevada. Most of this area is arid, having a mean annual rainfall of about 8½ inches. The river receives its water supply from the melting snows of the high mountains of Wyoming, Utah, and Colorado.

The water of the Colorado carries a large amount of sediment, reaching as high as 2,000 parts of sediment to 100,000 parts of water. The minimum amount is carried during the winter months, and probably is never less than 60 parts of sediment to 100,000 parts of water.

Prof. R. H. Forbes, in Bulletin No. 44, University of Arizona agricultural experiment station, says:

> On the basis of the profile constructed from available data for the volume of flow of the Colorado, and of the year's silt determinations made in this laboratory, it is estimated conservatively that the river during 1900 brought down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles 1 foot deep, or to make 53 square miles of dry, alluvial soil 1 foot deep, or to make about 164 square miles of recently settled, submerged mud 1 foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

A comparatively small amount of land is irrigated by the waters of Colorado River, owing to the fact that the main stream and both of its tributaries are situated so far below the level of the irrigable lands as to render their diversion extremely difficult or impracticable.

There are two pumping plants that lift water for irrigation at Yuma and several at other points on the river above Yuma. The Imperial canal diverts water at a point on the right bank of the river 10 miles by river below Yuma. It is the intention of the owners of this canal to reclaim a large tract of fertile land situated in Mexico and in California.

In a reconnaissance of Colorado River by J. B. Lippincott, numerous dam and reservoir sites and diversion points for canals were discovered, together with large tracts of fertile land capable of being irrigated. In November, 1902, extensive topographic, soil, and hydrographic surveys were begun in the Colorado River Valley by the Reclamation Service of the Geological Survey.

Colorado River has been called the Nile of America, and, like the Nile, it is subject to an annual summer rise, which comes at the time when it is most needed for irrigation. It is of interest to compare the Colorado with the Nile and Susquehanna rivers, the Nile being of a similar type, while the Susquehanna shows the difference of flow from arid and humid regions. In this comparison a normal year based upon the past ten years' records for the Colorado and Susquehanna rivers and such data as could be found in regard to the Nile has been used. The Colorado has been used as the standard for comparison.

The Nile has 5.7 times the drainage area and the Susquehanna about one-eighth the area.

The rainfall in the Nile basin is 3.8 times greater and that in the Susquehanna basin is about 4½ times greater.

The discharge of the Nile is 10.8 greater. That of the Susquehanna is 4½ times greater.

The run-off per square mile from the Nile basin is 1.9 times greater and that of the Susquehanna is 37 times greater.

The ratio of run-off to rainfall in the Nile basin is 2 times smaller and that of the Susquehanna is 8¼ times greater.

The maximum flow of the Colorado is from 70,000 to 75,000 second-feet and occurs in either May, June, or July. For the Nile it is about 353,000 second-feet and occurs about the 1st of September. For the Susquehanna it is from 200,000 to 400,000 second-feet and occurs during March, April, and May.

The mean flow of the Colorado is about 10,700 second-feet. For the Nile it is about 115,800 second-feet, and that for the Susquehanna is 43,000 second-feet.

The minimum flow of the Colorado is from 2,500 to 3,000 second-feet, and occurs during January and February. The minimum flow of the Nile is about 14,500 second-feet, and occurs about the end of May. For the Susquehanna it is from 2,500 to 5,000 second-feet, and occurs in September and October.

The principal tributaries of Colorado River are as follows: Gila River rises in the western part of New Mexico and flows west into the Colorado at Yuma, Ariz., draining the southern half of Arizona. Salt River, its principal tributary, joins it about 15 miles west of Phoenix, Ariz. Verde River and Tonto Creek are tributaries of Salt River from the north. San Juan River, with its tributaries, drains southwestern Colorado, northwestern New Mexico, and northeastern Arizona. It takes a generally westward course, joining the Colorado north of the Utah-Arizona boundary. Animas, Los Pinos, and Florida rivers are tributaries in southwestern Colorado. Grand River has its source on the Continental Divide, in the northern part of Colorado, and flows southwest to its junction with Green River. Gunnison River, its prin-

cipal tributary, joins it from the south, a short distance south of Grand Junction, Colo. Dolores River rises in southwestern Colorado and flows northwest into the Grand, in eastern Utah. Green River rises in the Wind River Mountains in the western-central part of Wyoming, its main source being in the lofty peaks of the Continental Divide. The source of its tributaries is also among the higher snow-covered ranges, maintaining the volume of this stream late into the summer. The principal branches of White River rise in White River Plateau, a well-forested tract in the White River Forest Reserve. A number of lakes, among which are Oyster, Marvin, Traverse, and Deep lakes, furnish important reservoir sites, if such are ever needed. Duchesne River, with its tributaries, Uinta River, Lake Creek, and Whiterocks River, flows into the Green near the mouth of White River and near Ouray, Utah. The Ashley is a small tributary of the Green, in northeastern Utah. Yampa River rises in the eastern part of Routt County, Colo., flows in a general westerly direction through the entire county, and empties into Green River near the western boundary. The stream is somewhat peculiar in its character, the upper branches having considerable fall, and the water, flowing rapidly over shoals of gravel and rock, is easily taken out for utilization.

COLORADO RIVER AT YUMA, ARIZ.

This station is located in the town of Yuma, Ariz., 1½ miles below the mouth of Gila River and 10 miles by river above the Mexican boundary. Records of the river height have been kept by the Southern Pacific Railway Company since April 1, 1878, on the gage which was established by Arthur Brown, superintendent of the bridge and building department of the Southern Pacific Railway Company, during the summer of 1876. The lower section of the rod, reading from 10 to 22 feet, is nailed to the pile protection on the right bank of the Southern Pacific Railway bridge. The upper section, reading above 22 feet, is fastened on the lower side of the first bridge pier from the left bank. This gage height, plus 100 feet, is the Southern Pacific elevation above the sea level. At a later date the Southern Pacific Railway Company established a vertical gage rod (the old rod still remaining) fastened to the pile protection on the left bank of the river just below the railway bridge. This gage has been used continuously since it was established (date unknown), and is the one used by the United States Geological Survey at present. It corresponds in elevation to the old gage established in 1876. The gage is read twice daily by W. D. Smith, who is employed as local hydrographer for the stations in this vicinity.

Discharge measurements are made by means of a ¾-inch cable supported on masts. At low water measurements are made from a boat held in place by a cable. A car is used at flood stages. The

initial point for soundings is the cable support on the south bank, about 20 feet from the water's edge at high water. The cable has a span of 650 feet. At low water the channel has a width of 325 feet. During floods a large part of the water flows through an old channel, and does not pass under the cable. It is measured at the point where it passes under the railway trestle. The channel of the main river is straight for 600 feet above and 5,000 feet below the station. The current is swift and the gaging section regular. The right bank is low, wooded, and liable to overflow. The left bank is not subject to overflow. The bed of the stream is composed of silt and sand and is very unstable. At low water a sand bar forms, which divides the channel into two parts. The bench mark is located on the first pier from the left bank. It is a standard bronze cap United States Geological Survey bench mark and has an elevation of 137 feet above sea level, as determined by the topographic branch of the Geological Survey. Its elevation above the zero of the gage is 35.31 feet.

The observations at this station during 1904 have been made under the direction of S. G. Bennett and W. B. Clapp, district hydrographers.

Discharge measurements of Colorado River at Yuma, Ariz., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
January 2	W. D. Smith	18.92	3,9[illegible]
January 5	do	18.84	4,0[illegible]
January 8	do	18.75	3,677
January 11	do	18.60	3,484
January 14	do	18.55	3,41[illegible]
January 16	do	18.70	3,512
January 19	do	18.60	3,407
January 21	do	18.75	3,684
January 23	do	18.75	3,5[illegible]
January 26	do	18.70	3,511
January 28	do	18.75	3,566
January 30	do	18.80	3,622
February 1	do	18.85	3,64[illegible]
February 4	do	18.90	3,[illegible]12
February 6	do	18.90	3,7[illegible]
February 9	do	18.75	3,484
February 11	do	18.70	3,342
February 13	do	18.75	3,540
February 16	do	18.75	3,48[illegible]
February 18	do	18.95	3,7[illegible]
February 20	do	19.05	3,78[illegible]
February 22	do	19.20	4,1[illegible]

Discharge measurements of Colorado River at Yuma, Ariz., in 1904—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
February 25	W. D. Smith	19.35	4,229
February 27	do	19.25	4,247
March 1	do	19.45	4,446
March 3	do	19.50	4,627
March 5	do	19.55	4,725
March 8	do	19.70	4,943
March 10	do	19.90	5,526
March 12	do	20.00	5,720
March 14	do	20.55	9,320
March 15	do	20.25	8,141
March 17	do	19.90	7,111
March 19	do	19.85	6,645
March 22	do	19.80	5,795
March 25	do	19.95	5,861
March 29	do	20.15	6,250
March 31	do	20.05	5,971
April 2	do	20.00	5,926
April 5	do	20.15	6,046
April 7	do	20.50	7,033
April 9	do	20.40	6,984
April 11	do	20.05	6,430
April 14	do	19.95	5,847
April 16	do	19.95	5,823
April 19	do	20.15	6,323
April 21	do	20.25	5,964
April 23	do	20.30	6,173
April 26	do	21.30	13,534
April 28	do	21.80	17,605
April 29	do	22.00	19,204
May 2	do	21.70	17,838
May 4	do	21.70	17,959
May 6	do	21.50	17,046
May 7	J. N. Johannsen	21.85	18,407
May 9	W. D. Smith	22.30	20,916
May 10	do	22.95	26,036
May 11	do	22.85	25,605
May 14	do	22.50	22,854
May 16	do	22.60	23,123
May 19	do	22.90	25,083
May 21	do	23.55	32,200

Discharge measurements of Colorado River at Yuma, Ariz., in 1904—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
May 23	W. D. Smith	23.95	32,52[illegible]
May 25	do	24.10	35,65[illegible]
May 27	J. N. Johannsen	24.70	40,8[illegible]
May 31	do	25.40	46,67[illegible]
June 2	do	25.95	46,9[illegible]
June 5	W. D. Smith	26.25	49,48[illegible]
June 7	do	26.00	51,17[illegible]
June 9	do	25.90	49,18[illegible]
June 11	do	25.50	45,82[illegible]
June 13	J. N. Johannsen	24.90	42,295
June 15	W. D. Smith	24.70	34,256
June 17	do	24.80	38,192
June 20	do	25.00	38,981
June 22	do	25.40	43,202
June 24	do	25.70	45,435
June 27	do	25.65	43,706
June 29	do	25.55	44,909
July 2	J. N. Johannsen	25.15	35,701
July 5	do	24.25	32,422
July 7	W. D. Smith	24.00	32,186
July 9	S. M. Smith	23.80	27,616
July 11	do	23.40	23,675
July 13	do	23.00	22,761
July 15	do	23.05	22,269
July 18	do	22.85	21,059
July 21	do	22.55	18,681
July 22	do	22.50	18,178
July 25	do	22.20	15,269
July 28	do	22.25	16,044
July 30	do	21.90	13,939
August 1	do	22.20	16,193
August 4	do	22.25	15,973
August 6	do	21.85	15,427
August 8	do	22.15	16,357
August 12	W. D. Smith	21.95	17,686
August 16	do	21.95	16,660
August 18	do	21.65	14,638
August 20	do	21.50	14,199
August 23	do	21.30	12,957
August 24	do	23.00	23,652

Discharge measurements of Colorado River at Yuma, Ariz., in 1904—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
August 26	W. D. Smith	22.25	18,740
August 30	S. M. Smith	22.80	23,185
September 1	do	22.10	18,358
September 5	do	22.00	18,060
September 7	do	22.40	18,351
September 9	do	21.80	15,773
September 13	do	21.00	12,940
September 15	do	20.90	11,772
September 19	do	20.35	8,063
September 22	W. D. Smith	20.10	7,682
September 26	do	19.60	6,508
September 28	do	19.45	5,984
September 30	do	19.30	5,538
October 4	do	19.30	6,014
October 6	do	20.95	12,408
October 10	do	20.90	11,193
October 14	do	21.85	19,134
October 17	do	22.35	21,603
October 19	do	21.15	14,579
October 22	do	20.60	11,476
October 25	do	20.20	10,055
October 29	do	19.95	8,825
November 1	do	20.00	7,964
November 5	do	19.85	6,955
November 8	do	19.65	6,544
November 12	do	19.65	6,430
November 15	do	19.65	6,423
November 19	do	19.50	5,948
November 23	do	19.30	5,269
November 26	do	19.10	5,156
November 30	do	19.05	4,754
December 3	do	19.10	5,080
December 6	do	19.05	4,797
December 10	do	19.00	4,819
December 13	do	18.85	4,696
December 17	do	18.85	4,756
December 19	do	19.10	4,822
December 24	do	18.40	3,641
December 29	do	18.40	3,933

Mean daily gage height, in feet, of Colorado River at Yuma, Ariz., for 190

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	18.92	18.85	19.45	20.05	22.00	25.70	25.30	22.25	22.10	19.30	20.00	19.10
2	18.92	18.85	19.50	20.00	21.75	25.90	25.15	22.20	22.00	19.30	20.00	19.10
3	18.88	18.90	19.50	20.00	21.80	26.10	24.90	22.20	22.10	19.30	20.00	19.10
4	18.84	18.90	19.55	20.00	21.70	26.25	24.45	22.25	22.40	19.30	19.90	19.05
5	18.84	18.90	19.55	20.15	21.50	26.25	24.25	21.95	21.95	19.55	19.85	19.00
6	18.84	18.90	19.55	20.20	21.50	26.20	24.05	21.85	22.25	20.95	19.80	19.00
7	18.79	18.85	19.60	20.50	21.85	26.00	24.00	22.10	22.30	20.30	19.70	19.05
8	18.75	18.80	19.70	20.60	22.10	25.90	23.95	22.10	22.00	20.20	19.65	19.05
9	18.74	18.75	19.80	20.40	22.30	25.90	23.80	22.25	21.75	20.30	19.60	19.00
10	18.65	18.75	19.90	20.20	22.80	25.70	23.50	22.20	21.45	20.90	19.60	19.00
11	18.60	18.70	20.00	20.05	22.90	25.50	23.40	22.20	21.10	20.60	19.60	18.90
12	18.51	18.70	20.00	20.00	22.65	25.30	23.15	21.95	21.00	20.70	19.65	18.90
13	18.47	18.75	20.40	20.00	22.65	24.90	23.00	22.10	20.95	21.40	19.65	18.85
14	18.55	18.75	20.55	19.95	22.50	24.70	23.00	21.95	20.90	21.85	19.65	18.85
15	18.64	18.75	20.25	19.90	22.40	24.70	23.05	21.95	20.90	22.30	19.65	18.80
16	18.70	18.75	19.95	19.95	22.60	24.70	22.90	21.95	20.60	22.80	19.60	18.80
17	18.70	18.85	19.90	19.90	22.70	24.80	22.85	22.00	20.50	22.35	19.50	18.85
18	18.70	18.95	19.85	19.95	22.70	24.55	22.85	21.75	20.50	22.00	19.50	19.05
19	18.60	19.00	19.85	20.15	22.90	24.80	22.75	21.40	20.30	21.15	19.50	19.10
20	18.70	19.05	19.85	20.30	23.25	25.10	22.55	21.50	20.25	21.00	19.50	19.00
21	18.75	19.10	19.85	20.25	23.60	25.30	22.50	21.30	20.10	20.75	19.40	18.85
22	18.75	19.20	19.80	20.30	23.90	25.40	22.40	21.30	20.10	20.60	19.30	18.70
23	18.75	19.15	19.80	20.30	23.95	25.50	22.30	21.30	19.95	20.40	19.30	18.50
24	18.75	19.20	19.90	20.30	24.05	25.70	22.25	23.00	19.85	20.30	19.30	18.40
25	18.75	19.30	19.95	20.50	24.10	25.70	22.10	23.00	19.70	20.20	19.20	18.35
26	18.70	19.35	19.95	21.30	24.40	25.60	22.10	22.25	19.60	20.10	19.10	18.30
27	18.70	19.25	19.95	21.60	24.70	25.65	22.05	22.10	19.55	20.10	19.10	18.30
28	18.75	19.25	20.10	21.80	24.95	25.55	22.25	22.10	19.45	20.10	19.05	18.30
29	18.75	19.30	20.15	22.00	25.00	25.55	22.00	22.40	19.35	19.95	19.05	18.40
30	18.80	.....	20.15	22.00	25.05	25.50	22.00	22.90	19.30	19.95	19.05	18.60
31	18.80	.....	20.05	.....	25.30	.....	22.30	22.25	.....	19.95	.....	18.56

Mean daily discharge, in second-feet, of Colorado River at Yuma, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,960	3,649	4,446	5,990	19,500	46,980	38,930	16,400	18,360	5,660	7,964	5,050
2	3,981	3,685	4,610	5,926	18,140	46,890	35,700	16,090	18,220	5,780	7,900	5,050
3	3,980	3,775	4,627	5,930	18,480	48,020	34,700	16,010	18,250	5,890	7,850	5,079
4	3,980	3,812	4,720	5,930	17,960	49,120	33,180	15,970	18,500	6,014	7,300	4,900
5	4,007	3,775	4,725	6,046	17,040	49,480	32,420	15,550	18,020	7,000	6,955	4,750
6	3,950	3,736	4,730	6,200	17,050	49,920	32,250	15,430	18,290	12,410	6,900	4,997
7	3,820	3,650	4,800	7,033	18,410	51,170	32,190	16,100	18,090	9,700	6,700	5,010
8	3,677	3,565	4,943	7,310	19,800	49,590	30,800	16,250	16,650	9,100	6,544	5,020
9	3,640	3,484	5,240	6,984	20,920	49,180	27,610	17,250	15,620	9,200	6,440	4,850
10	3,550	3,455	5,526	6,660	24,860	47,620	24,700	17,350	14,550	11,190	6,420	4,819
11	3,494	3,342	5,700	6,430	25,820	45,820	28,680	17,600	13,450	10,250	6,400	4,730
12	3,400	3,400	5,720	6,150	23,950	44,310	28,120	17,690	13,050	10,900	6,430	4,730
13	3,350	3,540	8,300	6,100	24,040	42,300	22,760	17,900	12,740	15,600	6,420	4,696
14	3,418	3,525	9,320	5,847	22,850	34,950	22,580	17,190	12,200	19,130	6,420	4,710
15	3,470	3,510	8,141	5,600	22,200	34,260	22,270	16,900	11,770	21,200	6,423	4,680
16	3,512	3,490	7,220	5,823	23,120	34,850	21,550	16,660	9,950	23,200	6,290	4,680
17	3,525	3,620	7,111	5,600	28,800	38,190	21,200	16,770	9,250	21,600	6,020	4,758
18	3,445	3,753	6,700	5,810	23,800	32,850	21,050	15,250	9,100	19,500	5,980	4,800
19	3,407	3,775	6,645	6,323	25,080	38,260	20,200	13,700	8,000	14,580	5,948	4,822
20	3,590	3,794	6,470	6,200	28,950	40,350	18,680	14,200	7,920	13,700	5,910	4,650
21	3,694	3,927	6,300	5,964	32,240	42,250	18,380	13,100	7,720	12,300	5,590	4,400
22	3,640	4,162	5,795	6,180	32,490	43,200	17,450	12,950	7,682	11,480	5,310	4,150
23	3,586	4,130	5,600	6,173	32,520	41,030	16,500	12,960	7,350	10,850	5,269	3,820
24	3,570	4,190	5,810	6,200	34,630	45,440	15,850	23,650	7,100	10,450	5,260	3,641
25	3,550	4,229	5,861	7,640	35,650	44,970	14,950	23,800	6,760	10,060	5,210	3,570
26	3,511	4,310	5,850	13,530	38,150	43,950	15,050	18,740	6,508	9,680	5,156	3,480
27	3,530	4,247	5,820	15,960	40,840	43,710	14,900	18,210	6,290	9,500	5,110	3,480
28	3,595	4,260	6,150	17,600	43,020	44,280	16,040	18,240	5,984	9,300	4,860	3,490
29	3,600	4,310	6,250	19,200	43,480	44,910	14,600	20,200	5,780	8,825	4,790	3,933
30	3,622	.....	6,220	19,400	43,900	43,590	14,580	24,000	5,538	8,550	4,754	4,100
31	3,635	.....	5,971	.....	45,900	.....	16,600	19,350	.....	8,290	.....	3,960

Estimated monthly discharge of Colorado River at Yuma, Ariz., for 1904.[a]

[Drainage area, 225,049 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
January	4,007	3,350	3,635	223,507	0.016	0.018
February	4,310	3,342	3,797	218,406	.017	.018
March	9,320	4,446	5,978	367,573	.027	.031
April	19,400	5,600	8,058	479,484	.036	.040
May	45,900	17,040	27,697	1,703,022	.123	.142
June	51,170	32,846	43,814	2,607,114	.195	.217
July	38,930	14,580	23,047	1,417,105	.102	.118
August	24,000	12,950	17,144	1,054,143	.076	.088
September	18,500	5,538	11,621	691,497	.052	.058
October	23,200	5,660	11,642	715,839	052	.060
November	7,964	4,754	6,151	366,009	.027	.030
December	5,079	3,480	4,477	275,305	.020	.023
The year	51,170	3,342	13,922	10,119,004	.062	.844

[a] Computed by indirect method devised by W. B. Clapp. See article in Engineering News, April 21, 1904.

Summary of evaporation record at Yuma, Ariz., for 1904.

Month.	Evaporation.	Temperature.						Rain.	Net evaporation.
		Evaporation pan.		Reservoir.		River.			
		7 a. m.	6 p. m.	7 a. m.	6 p. m.	7 a. m.	6 p. m.		
January	3.60	49.4	53.3	50.6	54.3	47.9	49.8	0.00	3.60
February	3.90	58.2	62.7	59.7	63.3	56.1	60.0	.00	3.90
March	6.47	63.8	68.8	65.9	69.8	61.8	62.3	.28	6.19
April	9.37	65.7	72.5	68.2	73.3	65.1	69.2	.00	9.37
May	10.01	72.2	77.7	74.1	78.0	70.0	73.8	.07	9.94
June	10.11	79.3	84.0	81.4	84.1	77.2	80.8	.00	10.11
July	10.24	83.6	83.1	85.6	89.4	81.8	82.7	.05	10.19
August	8.56	86.8	91.7	88.9	92.5	85.5	89.6	.69	7.87
September	6.62	80.6	86.5	81.4	86.3	80.2	83.4	.24	6.38
October	7.02	66.5	71.3	86.7	72.0	65.3	68.4	.00	7.02
November	4.41	56.4	60.7	59.2	62.1	54.8	57.7	.00	4.41
December	2.01	49.9	53.2	52.2	54.3	48.2	49.9	.10	1.91
Total	82.32							1.43	80.89
Mean		67.7	72.5	69.7	73.3	66.2	69.0		

IMPERIAL CANAL AT CALIFORNIA-MEXICO BOUNDARY LINE.

Imperial canal heads about 10 miles by river below Yuma, Ariz., on the California side. The station is located a half mile from the river and 600 feet below the wooden head gates. It was established October 24, 1903, by W. D. Smith. The vertical gage is located just above the boundary line on the right bank. It is read twice each day by J. S. Carter, the storekeeper. Discharge measurements are made by means of a boat and cable. The initial point for soundings is a charred post at the southeast corner of the corral, about 150 feet west of the right bank. The channel is straight for 600 feet above and 300 feet below the cable and has a width of 70 feet. The velocity is moderate. There is but one channel at all stages, but when the gage at Yuma reads about 26 feet the river overflows into the channel below the gaging section. The bed of the canal is composed of silt and sand, free from vegetation, and is very unstable. The right bank is low, and is liable to overflow. The left bank has an elevation of 6 feet above high water. Bench mark No. 1 is a standard United States Geological Survey iron bench-mark post. It is located near monument 207 of the United States and Mexico boundary line, on a hill about half a mile west of the gaging station. Its elevation is 52.41 feet above the zero of the gage and 155 feet above sea level. Bench mark No. 2 is a nail in a tree on the right bank. Its elevation is 15.20 feet above the zero of the gage. Bench mark No. 3 is a nail in a post near the ground on the right bank near the corral. Its elevation is 14.90 feet above the zero of the gage.

On October 6, 1904, a new heading was opened on Mexican territory 4 miles below the original station for the diversion of additional water from the Colorado River. Measurements were made in the canal below this heading in order to obtain the total diversion.

The observations at this station during 1904 have been made under the direction of S. G. Bennett and W. B. Clapp, district hydrographers.

Discharge measurements of Imperial canal at California-Mexico boundary line, head of canal (old gaging station), in 1904.

Date.	Hydrographer.	Gage height.	Discharge
		Feet.	*Second-feet*
January 1	W. D. Smith	8.60	4
January 15	do	8.30	41
January 27	do	8.30	4
February 12	do	8.30	4
February 26	do	8.82	5
March 16	do	10.16	7
Do	do	10.14	7
April 6	do	9.80	70
April 20	do	10.00	7
May 8	do	12.75	1,3
May 24	do	12.20	1,3
June 4	do	10.80	1,011
June 10	do	14.10	2,09
June 16	do	13.95	1,7
August 3	do	13.40	1,6
August 9	S. M. Smith	13.60	1,6
August 17	W. D. Smith	13.35	1,7
August 27	do	13.30	1,67
September 3	S. M. Smith	13.30	1,69
September 10	do	12.50	1,6
September 17	do	12.00	1,2
September 24	W. D. Smith	11.10	9
October 1	do	10.90	7

Mean daily gage height, in feet, of Imperial canal at California-Mexico boundary line, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	8.60	8.50	8.90	9.60	12.85	11.05	14.70	13.60	13.30	10.90
2	8.60	8.50	9.00	9.60	12.70	11.00	14.70	13.50	13.20	10.90
3	8.55	8.50	9.00	9.60	12.70	11.00	14.65	13.40	13.20	10.85
4	8.50	8.50	9.05	9.60	12.60	10.95	14.60	13.35	13.55	10.85
5	8.55	8.50	9.10	9.60	12.30	10.80	14.55	13.10	13.10	12.70
6	8.50	8.45	9.05	9.75	12.25	11.30	(a)	13.00	13.45	12.10
7	8.50	8.40	9.05	9.95	12.60	11.80	(a)	13.40	13.55	.....
8	8.50	8.35	9.10	10.15	12.85	13.10	(a)	13.20	13.20	.....
9	8.45	8.30	9.20	10.00	13.00	13.80	(a)	13.70	12.95	.....
10	8.40	8.20	9.30	10.00	13.35	14.00	(a)	13.60	12.55	12.60
11	8.35	8.35	9.45	9.90	13.50	13.95	(a)	13.65	12.10	.....
12	8.30	8.35	9.55	9.90	13.00	14.10	(a)	13.45	12.05	.....
13	8.20	8.35	9.95	9.80	12.70	a 14.20	(a)	13.45	12.10	.....
14	b 8.25	8.40	10.70	9.85	12.00	14.30	(a)	13.40	12.05	.....
15	b 8.25	8.40	10.50	9.90	11.90	14.10	(a)	13.20	12.10	14.15
16	b 8.25	8.40	10.20	9.90	12.15	14.00	(a)	13.30	11.90	(c)
17	b 8.25	8.50	10.05	9.95	12.30	14.05	(a)	13.25	11.95	.....
18	8.30	8.60	9.95	9.80	12.45	14.10	(a)	12.85	11.80	.....
19	8.30	8.60	9.85	9.85	12.70	14.25	(a)	12.70	11.65	.....
20	8.30	8.60	9.80	10.00	12.70	14.45	(a)	12.70	11.55	.....
21	8.40	8.60	9.60	10.10	12.55	14.60	(a)	12.60	11.30	.....
22	8.40	8.70	9.60	10.10	12.25	14.60	(a)	12.55	11.20	.....
23	8.40	8.70	9.50	10.15	12.20	14.60	(a)	12.50	11.20	.....
24	8.45	8.70	9.50	10.10	12.20	14.60	(a)	13.85	11.20	.....
25	8.35	8.70	9.60	10.20	12.15	14.60	(a)	14.10	11.15	.....
26	8.35	8.80	9.60	11.85	11.80	14.70	(a)	13.50	11.15	.....
27	8.30	8.80	9.65	12.50	11.00	14.75	13.10	13.20	11.20	.....
28	8.40	8.80	9.65	12.80	11.15	14.70	13.05	13.30	11.10	.....
29	8.40	8.80	9.65	12.80	11.15	14.70	13.00	13.55	11.05	.....
30	8.40	.....	9.70	12.80	11.00	14.70	13.40	14.10	10.90	.....
31	8.40	.....	9.80	.....	10.50	.....	13.55	13.50	.....	.....

a Gage destroyed; replaced July 27. b Estimated. c Station discontinued.

Discharge measurements of Imperial canal at heading in Mexico 4 miles below the International boundary line (new gaging station), in 1904.

Date.	Hydrographer.	Gage height.	Discharge
		Feet.	*Second-feet*
October 7	W. D. Smith	10.60	1,2[illegible]
October 15	do	12.75	1,9[illegible]
October 21	do	10.60	1,3[illegible]
October 28	do	9.35	1,0[illegible]
November 4	do	9.30	[illegible]
November 11	do	9.20	[illegible]
November 18	do	8.95	[illegible]
November 25	do	8.85	[illegible]
December 2	do	8.60	[illegible]
December 9	do	8.85	[illegible]
December 20	do	8.90	[illegible]
December 28	do	8.00	[illegible]

IMPERIAL VALLEY CANALS.

In July, 1904, stations were established on all canals entering the Imperial Valley as follows: Holt canal, Hemlock canal, Alamo channel, Alamitos canal, Main canal, and Boundary canal. These stations are located on United States territory, and in each case near the California-Mexico boundary line. Discharge measurements are made from foot bridges constructed at each station. The gages are vertical rods fastened to 4 by 4 inch timbers substantially embedded in the ground. Automatic water-stage registers, from which the daily gage height record is compiled, were placed at the first five stations mentioned above. These canals enter the valley east of Calexico, Cal. In October a canal, known as canal No. 6, was completed, which enters the valley west of Calexico, Cal. A station was constructed on this canal in November, and weekly discharge measurements are being made. A large quantity of waste water was discharging from the Imperial Valley below all irrigated lands, into the Salton basin. To determine this waste discharge measurements were made on New River at Brawley, on Alamo channel at Rockwood, and on canal No. 5 at Bernice.

The observations at these stations during 1904 were made under the direction of W. B. Clapp, district hydrographer.

Discharge measurements of Holt canal near Calexico, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 14	W. V. Hardy	2.02	62.0
July 23	do	1.79	53.6
July 26	do	1.75	48.4
July 29	do	1.72	44.0
August 2	do	1.70	43.0
August 5	do	1.70	41.8
August 10	do	1.88	50.0
August 17	do	2.03	59.0
August 23	do	1.96	56.0
August 26	do	1.97	56.0
September 3	W. V. Hardy and E. C. LaRue	2.03	60.0
September 10	do	2.14	61.0
September 18	do	1.63	37.0
September 24	S. M. Smith	1.60	36.0
September 27	do	1.55	33.0
October 1	do	1.90	49.0
October 5	do	1.73	41.0
October 8	do	2.03	56.0
October 15	do	1.97	48.0
October 22	do	1.98	47.0
October 29	do	1.61	30.0
November 4	do	1.62	36.3
November 11	W. V. Hardy and S. M. Smith	1.95	54.0
November 18	W. V. Hardy	1.92	50.0
November 25	do	1.72	40.0
December 2	do	1.52	32.0
December 8	do	1.65	37.0
December 15	do	1.46	27.0
December 22	do	1.58	32.0

Mean daily gage height, in feet, of Holt canal near Calexico, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	.....	1.85	2.00	1.90	1.60	1
2	.....	1.70	2.10	1.80	1.55	1
3	.....	1.70	2.00	1.80	1.55	1
4	.....	1.70	2.00	1.80	1.60	1
5	.....	1.70	2.00	1.75	1.70	1
6	.....	1.65	1.90	1.70	1.80	1
7	.....	1.60	1.90	1.80	1.65	1
8	.....	1.80	2.10	2.00	2.15	1
9	.....	1.85	2.10	2.00	2.15	1
10	.....	1.90	2.15	1.85	2.05	1
11	.....	1.90	2.15	1.80	2.00	1.6
12	.....	1.90	2.10	1.85	1.90	1.6
13	.....	1.95	1.90	1.90	1.90	1.6
14	.....	1.95	1.70	1.85	1.90	1
15	.....	2.00	1.65	1.80	1.85	1.5
16	.....	2.00	1.60	1.90	1.85	1.5
17	.....	2.05	1.55	1.90	1.90	1.45
18	.....	2.05	1.60	1.95	1.90	1.5
19	.....	2.05	1.60	1.95	1.90	1
20	.....	(2.05)	1.60	1.95	1.90	1.4
21	.....	(2.05)	1.65	2.00	1.85	1.5
22	1.80	(2.00)	1.55	1.95	1.85	1.5
23	1.80	1.95	1.55	1.85	1.80	1.45
24	1.75	(1.95)	1.55	1.75	1.75	1.5
25	1.70	(1.95)	1.55	1.60	1.75	1.5
26	1.75	1.95	1.50	1.65	1.75	1.6
27	1.80	2.00	1.55	1.70	1.75	1.5
28	1.75	2.05	1.50	1.65	1.70	1.65
29	1.70	2.00	1.50	1.60	1.70	1.6
30	1.35	1.90	1.70	1.60	1.65	1.6
31	1.90	2.00	.....	1.60	.....	1.6

NOTE.—Gage heights in parenthesis are estimated.

Discharge measurements of Hemlock canal near Calexico, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 23	W. V. Hardy	0.95	4.4
July 26	do	1.15	6.4
July 29	do	1.14	6.0
August 2	do	.92	3.6
August 5	do	1.20	7.3
August 10	do	1.00	4.4
August 17	do	1.08	5.7
August 23	do	1.03	5.0
August 26	do	1.02	4.9
September 3	W. V. Hardy and E. C. LaRue	1.02	4.3
September 10	do	1.07	4.6
September 18	do	1.44	11.5
September 24	S. M. Smith	1.10	3.9
September 27	do	1.10	4.5
October 1	do	1.79	14.5
October 5	do	1.15	5.4
October 8	do	1.31	8.2
October 15	do	1.45	8.8
October 22	do	1.50	10.6
October 29	do	.98	3.1
November 4	do	1.13	6.4
November 11	W. V. Hardy and S. M. Smith	1.29	8.0
November 18	W. V. Hardy	1.31	8.2
November 25	do	1.28	8.0
December 2	do	1.39	9.5
December 8	do	1.13	6.3
December 15	do	1.04	3.3
December 22	do	.88	1.8

Mean daily gage height, in feet, of Hemlock canal near Calexico, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.95	0.95	1.70	1.05	1.20
2	.....	.90	.95	1.50	1.10	1.40
3	.....	.95	1.00	1.40	1.15	1.40
4	.....	1.10	1.05	1.35	1.15	1.40
5	.....	1.20	1.05	1.15	1.20	1.30
6	.....	1.30	1.05	1.05	1.25	.95
7	.....	(a)	1.05	1.05	1.35	1.15
8	.....	(a)	1.05	1.15	1.40	1.15
9	.....	.90	1.05	.85	1.35	1.10
10	.....	1.00	1.10	.80	1.30	1.10
11	.....	1.00	1.10	.75	1.30	1.10
12	.....	.80	1.05	.65	1.30	1.10
13	.....	.90	1.05	.95	1.30	1.10
14	.....	1.05	1.00	1.30	1.30	1.10
15	.....	1.05	1.05	1.45	1.35	1.00
16	.....	1.05	1.10	1.45	1.45	1.00
17	.....	1.10	1.05	1.45	1.45	.95
18	.....	1.05	1.20	1.45	1.35	.95
19	.....	1.10	1.65	1.45	1.30	.90
20	.....	(1.05)	1.35	1.50	1.30	.90
21	.....	(1.05)	1.10	1.50	1.30	.90
22	1.00	(1.05)	1.00	1.50	1.30	.90
23	.95	1.05	1.00	1.45	1.30	.85
24	1.00	(1.05)	1.00	1.35	1.30	.80
25	1.05	(1.00)	1.05	1.25	1.30	.80
26	1.15	1.00	1.10	1.15	1.30	.65
27	1.15	(1.05)	1.25	1.05	1.30	.60
28	.75	(1.05)	1.45	1.00	1.30	.75
29	1.15	(1.20)	1.35	1.00	1.25	(.75)
30	1.15	(1.25)	1.35	1.05	1.20	(.75)
31	1.00	(1.05)	.....	1.05	.....	(.75)

(a) Dry.

NOTE.—Gage heights in parentheses are estimated.

Discharge measurements of Alamo channel near Calexico, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 14	W. V. Hardy	3.20	144
July 23	do	2.80	115
July 26	do	3.09	138
July 29	do	3.51	177
August 2	do	1.63	39
August 5	do	1.61	36.5
August 10	do	3.38	163
August 17	do	3.82	219
August 23	do	3.67	200
August 26	do	3.68	197
September 3	W. V. Hardy and E. C. LaRue	4.00	239
September 10	do	4.00	256
September 18	do	2.95	136
September 24	S. M. Smith	2.77	124
September 27	do	2.80	135
October 1	do	3.79	240
October 5	do	2.65	123
October 8	do	3.55	205
October 15	do	3.40	182
October 22	do	3.82	228
October 29	do	3.05	157
November 4	do	2.97	146
November 11	W. V. Hardy and S. M. Smith	3.04	152
November 18	W. V. Hardy	2.43	97
November 25	do	2.22	86
December 2	do	2.14	80
December 8	do	2.56	107
December 15	do	2.55	111
December 22	do	2.32	80

Mean daily gage height, in feet, of Alamo channel near Calexico, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.80	(3.90)	3.75	2.95	2.10
2	.....	1.65	(3.90)	3.35	2.95	2.15
3	.....	1.65	4.00	3.00	2.95	2.15
4	.....	1.60	4.00	(2.70)	3.00	2.30
5	.....	1.60	4.00	2.65	2.70	2.30
6	.....	1.80	4.00	3.55	2.50	2.35
7	.....	2.50	4.00	2.75	2.50	2.35
8	.....	2.65	4.00	3.25	(3.00)	2.55
9	.....	2.85	4.00	3.50	(3.00)	2.55
10	.....	3.40	4.00	3.45	(3.00)	2.60
11	.....	3.60	4.00	3.40	3.00	2.60
12	.....	3.60	3.95	3.40	2.75	2.60
13	.....	3.50	3.65	3.40	2.50	2.60
14	.....	3.65	3.85	3.35	(2.40)	2.55
15	.....	3.65	(3.00)	3.40	(2.40)	2.55
16	.....	3.75	(2.90)	3.45	(2.40)	(2.55)
17	.....	3.80	(2.90)	3.40	(2.40)	(2.55)
18	.....	3.80	2.90	3.50	2.40	(2.50)
19	.....	3.80	2.90	3.75	2.40	(2.50)
20	.....	3.80	2.90	3.80	3.40	(2.40)
21	.....	3.80	2.80	3.85	2.35	(2.35)
22	3.25	3.80	2.70	3.80	2.30	2.30
23	2.80	3.65	2.75	3.70	2.25	2.15
24	2.90	3.65	2.75	3.25	2.25	2.00
25	2.95	3.70	2.80	3.20	2.20	(2.00)
26	3.10	3.70	2.75	3.25	2.25	(2.00)
27	3.30	3.80	2.80	3.15	2.25	(1.90)
28	3.40	3.80	2.75	3.05	2.20	(1.80)
29	3.50	3.80	2.95	3.00	2.15	1.75
30	3.60	3.80	3.40	3.00	2.10	(1.75)
31	3.80	3.80	.....	2.95	.....	(1.75)

NOTE.—Gage heights in parenthesis are estimated.

Discharge measurements of Alamitos canal near Calexico, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 14	W. V. Hardy	1.40	26.6
July 23	do	1.48	24.3
July 26	do	1.30	18.4
July 29	do	1.50	26.3
August 2	do	1.08	8.2
August 5	do	1.04	13.3
August 10	do	.81	3.0
August 17	do	1.20	17.7
August 23	do	1.17	17.4
August 26	do	1.13	15.6
September 3	do	1.10	16.3
September 10	do	1.15	21.0
September 18	do	1.39	31.0
September 24	S. M. Smith	.87	8.3
September 27	do	1.02	13.7
October 1	do	1.10	8.4
October 5	do	1.19	18.7
October 8	do	1.54	36.0
October 15	do	1.50	35.0
October 22	do	1.30	26.0
October 29	do	1.24	25.0
November 4	do	1.21	23.0
November 11	S. M. Smith and W. V. Hardy	1.37	30.0
November 18	W. V. Hardy	1.48	35.0
November 25	do	1.48	26.0
December 2	do	1.34	22.0
December 8	do	1.41	25.0
December 15	do	1.43	26.0
December 22	do	1.46	29.0

Mean daily gage height, in feet, of Alamitos canal near Calexico, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	.....	1.00	(1.10)	1.10	1.25	1.35
2	.....	1.10	(1.10)	.65	1.25	1.35
3	.....	1.10	1.10	.90	1.25	1.35
4	.....	1.05	1.05	1.15	1.25	1.35
5	.....	1.05	1.10	1.25	1.30	1.[illegible]
6	.....	1.00	1.10	1.30	1.35	1.4[illegible]
7	.....	1.00	(1.10)	1.40	1.25	1.4[illegible]
8	.....	.90	1.15	1.45	1.20	1.4[illegible]
9	.....	1.00	1.15	1.35	1.25	1.50
10	.....	.80	1.15	1.35	1.30	1.60
11	.....	.90	1.15	1.35	1.35	1.45
12	.....	.85	1.20	1.35	1.45	1.40
13	.....	.95	1.15	1.40	1.45	1.45
14	.....	1.00	1.15	1.45	1.45	1.45
15	.....	1.10	1.10	1.50	1.45	1.45
16	.....	1.15	1.15	1.55	1.45	1.45
17	.....	1.20	1.25	1.10	1.45	1.45
18	.....	1.20	1.40	.90	1.50	1.45
19	.....	1.20	1.30	.80	1.45	1.45
20	.....	(1.20)	1.25	1.15	(a)	1.50
21	.....	1.15	1.15	1.35	(a)	1.50
22	1.40	(1.10)	1.10	1.30	1.35	1.45
23	1.50	1.10	1.00	1.30	1.40	1.40
24	1.40	(1.05)	.95	1.25	1.40	1.35
25	1.35	(1.05)	1.10	1.25	1.40	1.25
26	1.30	1.05	1.05	1.25	1.40	1.30
27	1.35	1.05	1.05	1.25	1.40	1.30
28	1.40	(1.05)	1.10	1.25	1.40	1.40
29	1.50	(1.05)	1.15	1.25	1.40	(1.40)
30	1.50	(1.00)	1.00	1.25	1.40	(1.40)
31	1.65	(1.00)	.....	1.25	.....	(1.40)

a Dry.

NOTE.—Gage heights in parenthesis are estimated.

Discharge measurements of Imperial canal (main) near Calexico, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 14	W. V. Hardy	4.60	615
July 21	do	4.60	642
July 23	do	4.53	625
July 26	do	4.32	598
July 29	do	4.03	519
August 2	do	4.73	652
August 5	do	4.83	677
August 10	do	4.16	556
August 17	do	4.72	644
August 23	do	4.74	669
August 26	do	4.76	696
September 3	do	4.93	717
September 10	do	4.91	682
September 18	do	4.62	662
September 24	do	4.27	573
September 27	S. M. Smith	4.10	560
October 1	do	3.11	249
October 5	do	3.97	474
October 8	do	4.13	548
October 15	do	4.59	642
October 22	do	4.70	639
October 29	do	4.63	656
November 4	S. M. Smith and W. V. Hardy	4.45	598
November 11	do	4.41	601
November 18	W. V. Hardy	4.62	620
November 25	do	4.54	602
December 2	do	4.48	586
December 8	do	4.45	573
December 15	do	4.42	561
December 22	do	4.40	563

Mean daily gage height, in feet, of Imperial canal (main) near Calexico, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.60	4.85	2.90	4.50	4.[illegible]
2	.....	4.75	4.90	3.50	4.50	4.45
3	.....	4.70	4.95	3.80	4.45	4.45
4	.....	4.85	4.90	4.05	4.45	4.45
5	.....	4.80	4.90	4.00	4.50	4.50
6	.....	4.80	4.90	3.95	4.55	4.50
7	.....	4.70	4.90	4.00	4.25	4.45
8	.....	4.55	4.90	4.15	4.25	4.[illegible]
9	.....	4.40	4.90	4.25	4.30	4.[illegible]
10	.....	4.15	4.90	4.40	4.35	4.[illegible]
11	.....	4.20	4.90	4.40	4.40	4.45
12	.....	4.30	4.85	4.40	4.50	4.45
13	.....	4.40	4.80	4.40	4.55	4.45
14	4.60	4.55	4.75	4.55	4.55	4.[illegible]
15	4.60	4.65	4.75	4.60	4.55	4.40
16	4.70	4.65	4.75	4.60	4.60	(4.40)
17	4.60	4.70	4.65	4.70	4.60	(4.40)
18	4.60	4.75	4.60	4.75	4.60	(4.40)
19	4.60	4.90	4.60	4.80	4.65	(4.40)
20	4.60	4.75	4.55	4.75	4.70	(4.45)
21	4.60	4.75	4.55	4.70	4.70	(4.40)
22	4.55	4.75	4.50	4.70	4.60	4.40
23	4.55	4.75	4.35	4.65	4.55	4.35
24	4.50	4.75	4.15	4.65	4.55	4.30
25	4.45	4.75	4.10	4.60	4.55	4.20
26	4.30	4.75	4.10	4.65	4.55	4.15
27	4.25	4.80	4.15	4.60	4.60	4.10
28	4.00	4.80	4.15	4.60	4.55	4.00
29	4.00	4.85	4.10	4.65	4.55	(4.00)
30	4.00	4.85	3.80	4.60	4.50	(4.0
31	4.10	4.85	.....	4.55	.....	(4.0

NOTE.—Gage heights in parenthesis are estimated.

Discharge measurements of Boundary canal near Calexico, Cal., 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 23	W. V. Hardy	1.20	10.0
July 26	do	1.20	10.0
July 29	do	1.15	9.1
August 2	do	1.65	12.7
August 5	do	1.10	13.0
August 10	do	1.06	10.5
August 17	do	.91	8.3
August 23	do	.85	11.9
August 26	do	1.10	15.6
September 3	W. V. Hardy and E. C. LaRue	1.07	13.2
September 10	do	1.08	12.9
September 18	do	.85	7.5
September 24	S. M. Smith	.99	11.0
September 27	do	.90	9.9
October 1	do	1.00	10.8
October 5	do	1.00	10.0
October 8	do	1.00	9.4
October 15	do	.90	5.9
October 22	do	.10	7.0
October 29	do	.10	7.0
November 4	W. V. Hardy	.78	6.2
November 11	S. M. Smith and W. V. Hardy	.85	6.6
November 18	W. V. Hardy	.82	6.3
November 25	do	.82	6.2
December 2	do	.84	7.0
December 8	do	.65	4.8
December 15	do	.74	5.5
December 22	do	.46	4.0

DUTY OF WATER AND SEEPAGE INVESTIGATIONS MADE AT YUMA, ARIZ.

By W. D. Smith.

The following is a statement of the investigations made on the duty of water for mixed crops under the right and left branches of the Colorado Valley Pumping and Irrigation Company's canal, the duty of water for alfalfa on the Laselle and the Rose ranches, and the seepage loss in the left branch of the Colorado Valley Pumping and Irrigation Company's canal (commonly known as the Ives ditch). All of these lands lie in the upper part of the Yuma Valley, within 6 miles of Yuma, where the pumping plant is located. The results are representative of the Yuma project as a whole, with the exception of the seepage loss, which is believed to be somewhat high.

The climatic conditions have been normal. At the end of the year the zanjero, Mr. S. P. Huss, was asked if he thought the amount of water used was more or less than usual, and he said, "Probably a little less, for the following reasons: Colorado River during the months of August, September, and October, has carried an abnormal amount of fine light mud, due to the heavy discharge of Gila River and other Arizona streams. This was carried through the canals to the lands irrigated, and prevented the water from soaking in readily. In the same way seepage in the ditches was reduced." Mr. Huss states that he observed a marked difference in the amount of time it required to irrigate the same acreage with a given head of water, and that this was not entirely offset by more frequent irrigations. The alfalfa crop appears to have been slightly reduced from this cause. The water costs the irrigators $1 or more per acre-foot, and is, therefore, not wasted; but the scattering location of the farms and the slow velocity of water in the canals and laterals increases the amount lost by seepage. The areas were obtained from the best available sources. The Laselle and Rose ranches were surveyed by the writer.

Four measuring flumes were used, on which nilometer records were kept. Weir measurements would have been unsatisfactory on account of the large amount of sediment carried in the water. The rating of these flumes was constantly changing by the steady filling of the canals with silt. This necessitated frequent ratings or single meter measurements, and at the end of the year, or just before the cleaning of the canal of silt, tables were constructed for periods of from two weeks to two or three months, according to conditions.

Another serious difficulty was the light grade of the canals and the fact that they were discharging nearly their full capacity. This made it almost impossible to locate the flumes where the rating would not be affected by check gates in the canal. In the case of flumes Nos. 2 and 4 this might have been overcome by locating them above the company's weirs, but the advantages would have been offset by the fact that here

the canals are more often cleaned of silt. The flumes were rated with the check gates removed and with them in place, designated as "rating *a*" and "rating *b*," respectively. This would not have been a complete success without the hearty cooperation of the zanjero, Mr. S. P. Huss, in operating the check gates and keeping a record of the same when requested; also the cooperation of Mr. J. M. Boxley and Mr. John Lamar, managers of the Laselle and Rose ranches, respectively.

By the kindness of the engineer, Mr. H. Alexander, another check was obtained on the "*a*" and "*b*" ratings, and on the clock records as a whole. Mr. Alexander kept an accurate record for the whole year of the number of hours the pump was in operation each day, and the number of irrigating heads pumped. An irrigating head is about 12 second-feet.

Flume No. 4 is the property of the Agricultural Experiment Station at Tucson, Ariz. The nilometer on this flume is of French make. The other three were manufactured by Julian P. Friez, of Baltimore, Md. The French machine gave much better results than the latter. In carrying out this work, no impossible degree of accuracy has been attemped; but no pains have been spared to make the results absolutely reliable and reasonably accurate.

Monthly duty of water of right branch of Colorado Valley Pumping and Irrigation Company's canal at Yuma, Ariz.

Month.	Acre-feet.	
	Total.	Per acre.
January	356.0	0.20
February	517.9	.29
March	1,188.5	.66
April	966.2	.54
May	966.3	.54
June	1,284.6	.71
July	1,033.1	.57
August	576.9	.32
September	794.0	.44
October	748.4	.41
November	0.0	.00
December	316.0	.18
Total	8,747.8	4.86

NOTE.—The above includes seepage losses. Crops, mixed. Net area, 1,800 acres.

Monthly duty of water of left branch of Colorado Valley Pumping and Irrigation Company's canal at Yuma, Ariz.

Month.	Acre-feet.	
	Total.	Per acre.
January	100.7	0.2
February	105.5	.2
March	174.5	.3
April	249.6	.5
May	243.8	.5
June	398.0	.8
July	330.8	.7
August	245.8	.55
September	204.0	.45
October	223.9	.5
November	0.0	.0
December	51.5	.12
Total	2,328.1	5.15

NOTE.—The above includes seepage losses. Crops, mixed. Net area, 450 acres.

Monthly duty of water at Laselle ranch, Yuma, Ariz.

Month.	Acre-feet.	
	Total.	Per acre, alfalfa.
January	76.0	0.58
February	48.5	.37
March	64.3	.49
April	66.9	.51
May	109.1	.83
June	53.3	.40
July	140.7	1.07
August	65.3	.49
September	80.9	.61
October	74.9	.57
November	0.0	.00
December	0.0	.00
Total	779.9	5.92

NOTE.—Acreage, net: Alfalfa, 128 acres; wheat, 17 acres; total, 145 acres, which is equivalent to 132 acres of alfalfa.

REMARKS.—The measuring flume is 1,100 feet above the first lateral, so that the loss by seepage after passing the flume and before reaching the ranch is probably about 1 per cent. The soil is very sandy. Most of the alfalfa was cut, but a part was used as pasture. Plenty of water was used, but apparently none was wasted.

Monthly duty of water at Rose ranch, Yuma, Ariz.

Month.	Acre-feet.	
	Total.	Per acre.
January	0.0	0.00
February	0.0	.00
March	13.8	.72
April	15.2	.79
May	10.0	.52
June	14.9	.77
July	12.3	.64
August	8.0	.42
September	8.2	.43
October	13.8	.72
November	0.0	.00
December	2.2	.11
Total	98.4	5.12

NOTE.—Acreage, net: Alfalfa, 19.26 acres.

REMARKS.—7.19 acres of above was wheat and young alfalfa, so irrigated as to make total equivalent to 17.7 acres of old alfalfa. These measurements were made at the ranch and do not include loss by seepage.

Monthly duty of water of Colorado Valley Pumping and Irrigation Company's canal, Yuma, Ariz.

Month.	Acre-feet.		
	Total.	Per acre, gross area.	Per acre, net area.
January	456.7	0.07	0.20
February	623.4	.10	.28
March	1,363.0	.21	.60
April	1,215.0	.19	.54
May	1,210.1	.19	.54
June	1,682.6	.26	.75
July	1,363.9	.21	.60
August	822.7	.13	.37
September	998.0	.15	.44
October	972.2	.15	.43
November	0.0	.00	.00
December	367.5	.06	.16
Total	11,075.9	1.72	4.91

NOTE.—The above includes loss by seepage.

REMARKS.—Mixed crops: Alfalfa, 1,365 acres; grain, 475 acres; corn and sorghum, 245 acres; miscellaneous, 165 acres. Total net area, 2,250 acres; total gross area, 6,500 acres. Number of irrigators, 75.

Cost of pumping, Colorado Valley Pumping and Irrigation Company's Canal, Yuma, Ariz.

Irrigation No.	Month.	Hours pumping.	Acre-feet pumped.	Average lift.	Expense.	Cost per acre-foot.	Cost per foot for raising acre-foot
1	January	156	457	11.5	$240	$0.53	$0.04
2	February	342	1,173	10.8	564	.48	.044
3	March	230	816	10.5	411	.50	.048
4	April	380	1,216	10.1	607	.50	.050
5	May	183	582	8.7	312	.54	.062
6	May	213	628	7.5	310	.50	.067
7	June	200	623	5.1	271	.43	.084
8	June	220	685	6.4	311	.45	.070
9	June	240	718	6.3	330	.46	.073
10	July	220	706	8.3	362	.51	.06
11	August	300	644	8.9	345	.54	.06
12	August	200	439	8.9	260	.59	.07
13	September	180	480	8.9	340	.71	.08
14	September	175	572	10.7	354	.62	.05
15	October	200	574	9.7	310	.54	.05
16	October	200	456	10.1	302	.66	.06
17	December	180	368	11.4	315	.86	.07
	Total	3,819	11,079	9.05	5,944	.54	.06

NOTE.—The engineer's salary is $100 per month, and this increased the cost per acre-foot in the months when little water was pumped.

Monthly expense.

Month.	Labor.	Wood.	Oil.	Miscellaneous.	Total
January	$88	$126	$0	$17	$2
February	132	4	170	27	33
March	174	91	320	45	63
April	180	88	312	26	60
May	172	91	305	32	60
June	188	130	340	32	69
July	190	140	328	36	69
August	174	10	352	30	56
September	158	63	280	35	53
October	172	80	288	51	59
November	100	0	0	9	10
December	134	70	80	74	35
Total	1,862	893	2,775	414	5,94

Seepage loss, Ives ditch (Left Branch Colorado Valley Pumping and Irrigation Company's canal) at Yuma, Ariz.

[Distance, 4.26 miles.]

	Per cent.
March 21	10
April 18	17
May 9	14
May 23	18
July 2	19
July 17, a. m	16
July 17, p. m	18
Mean	16

REMARKS.—This is the loss between flumes No. 2 and No. 3. The water travels this distance in four and one-half hours. In each case the register records show a constant head, and meter gagings were made in flume No. 3 (the lower one). In addition to this meter gagings were made in flume No. 2 on May 9, May 23, and July 17, a. m. For the remaining determinations the discharge at flume No. 2 was taken from the rating tables. In each case search was made along the ditch for leaks, and there was a very small loss from this source, which was estimated to be about 2 per cent, making the actual loss by seepage about 14 per cent. The ditch has not been cleaned for several years and is heavily silted, but it passes through a sandy part of the valley.

GREEN RIVER AT GREENRIVER, WYO.

This station was established May 2, 1895. It was located at the pump house at a point about 40 feet below the bridge of the Union Pacific Railroad Company. The gage is a plain staff, graduated to feet and tenths, securely fastened to heavy submerged cribbing on the east bank of the river. Here the water runs in four channels at flood times, but can not possibly overflow beyond, because of the high railroad embankments. The bench mark is a cross on the third step from the bottom of the south end of the east abutment of the railroad bridge. Its elevation was 12.48 feet above the zero of the gage. During the winter of 1903–4 the gage was raised from its original position, and now the bench mark is 12.46 feet above the zero of the gage. As the section under the railroad bridge is poor, discharge measurements are made from the iron highway bridge about one-half mile below. The initial point for soundings is the end of the bridge on the left bank, sounding points being indicated by notches cut in the railing of the bridge on downstream side, and the distance from initial point marked. The channel is straight for about 500 feet above and 300 feet below the station. The current is swift at high water and sluggish when at its lower levels. The stream is confined within the banks and runs in a single channel during low-water periods, when the entire right half of the channel is a bed of clean sand, shifting more or less each year, but as it rises the water extends across the two channels and under the approaches of the bridge. The station was temporarily discontinued during the latter part of 1900 and part of 1901, and no discharge measurements were made in 1903.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Green River at Greenriver, Wyo., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 19	A. J. Parshall	506	1.82	0.90	923
April 8	do	654	2.11	1.60	1,380
April 29	do	868	3.30	2.85	2,864
May 16	do	1,130	3.70	3.35	4,185
May 26	do	2,156	5.87	5.50	12,640
June 4	do	2,006	5.27	5.00	10,570
June 19	do	2,127	5.54	5.30	11,740
June 30	do	1,642	4.58	4.20	7,523
September 26	do	414	1.52	1.05	63[illegible]
September 26	do	428	1.48	1.05	635
October 21	do	436	1.69	1.17	73[illegible]

Mean daily gage height, in feet, of Green River at Greenriver, Wyo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.70	2.98	4.88	4.15	3.12	1.88	1.0[illegible]
2	1.78	3.00	4.98	4.25	3.10	1.95	1.0[illegible]
3	1.65	3.08	5.02	4.35	3.02	1.95	.[illegible]
4	1.88	3.15	5.00	4.30	2.88	1.95	.9[illegible]
5	1.75	3.12	4.68	4.15	2.65	1.92	1.0[illegible]
6	1.90	3.05	4.35	4.10	2.62	1.82	1.0[illegible]
7	1.98	3.08	4.20	4.10	2.52	1.68	1.0[illegible]
8	1.65	3.20	4.28	4.02	2.48	1.60	1.0[illegible]
9	1.40	3.12	4.58	4.00	2.42	1.52	1.0[illegible]
10	1.38	2.85	4.90	3.92	2.40	1.48	1.0[illegible]
11	1.50	2.72	4.80	3.82	2.35	1.45	1.0[illegible]
12	1.92	2.95	4.92	3.72	2.35	1.40	1.0[illegible]
13	2.35	3.05	5.05	3.70	2.40	1.38	1.0[illegible]
14	2.40	3.10	4.98	3.68	2.40	1.35	1.0[illegible]
15	2.62	3.15	4.90	3.62	2.50	1.30	1.0[illegible]
16	2.70	3.30	5.02	3.50	2.48	1.30	1.0[illegible]
17	2.35	3.48	5.18	3.42	2.40	1.25	1.0[illegible]
18	2.30	3.60	5.25	3.38	2.35	1.25	1.0[illegible]
19	2.28	3.75	5.30	3.30	2.32	1.20	1.0[illegible]
20	2.38	3.92	5.30	3.22	2.28	1.20	1.0[illegible]
21	2.58	4.25	5.30	3.20	2.25	1.20	1.0[illegible]
22	2.80	4.75	5.38	3.15	2.25	1.18	1.0[illegible]
23	2.55	4.80	5.42	3.10	2.22	1.15	1.0[illegible]
24	2.38	4.82	5.45	3.10	2.18	1.15	1.0[illegible]
25	2.30	5.20	5.45	3.22	2.08	1.10	1.0[illegible]
26	2.12	5.55	5.22	3.30	2.02	1.10	1.0[illegible]
27	2.30	5.70	4.88	3.35	2.02	1.05	1.0[illegible]
28	2.52	5.35	4.52	3.30	1.92	1.00	1.0[illegible]
29	2.80	4.70	4.30	3.22	1.85	1.00	1.0[illegible]
30	3.15	4.58	4.12	3.18	1.85	1.00	1.0[illegible]
31	.....	4.72	.....	3.15	1.80	.....	1.0[illegible]

Rating table for Green River at Greenriver, Wyo., from April 1 to July 15, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	1,110	2.50	2,300	3.70	5,540	4.90	10,100
1.40	1,170	2.60	2,465	3.80	5,920	5.00	10,480
1.50	1,235	2.70	2,645	3.90	6,300	5.10	10,860
1.60	1,305	2.80	2,840	4.00	6,680	5.20	11,240
1.70	1,380	2.90	3,050	4.10	7,060	5.30	11,620
1.80	1,460	3.00	3,280	4.20	7,440	5.40	12,000
1.90	1,550	3.10	3,530	4.30	7,820	5.50	12,380
2.00	1,650	3.20	3,800	4.40	8,200	5.60	12,760
2.10	1,760	3.30	4,095	4.50	8,580	5.70	13,140
2.20	1,880	3.40	4,420	4.60	8,960		
2.30	2,010	3.50	4,780	4.70	9,340		
2.40	2,150	3.60	5,160	4.80	9,720		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 1.30 feet and 5.50 feet. The table has been extended above gage height 5.50 feet. Above gage height 3.50 feet the rating curve is a tangent, the difference being 380 per tenth.

Rating table for Green River at Greenriver, Wyo., from July 16 to October 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	575	1.40	855	2.20	1,730	2.90	2,970
.95	597	1.50	930	2.30	1,870	3.00	3,210
1.00	620	1.60	1,015	2.40	2,020	3.10	3,470
1.05	645	1.70	1,115	2.50	2,180	3.20	3,750
1.10	670	1.80	1,225	2.60	2,355	3.30	4,060
1.15	697	1.90	1,340	2.70	2,545	3.40	4,400
1.20	725	2.00	1,465	2.80	2,750	3.50	4,780
1.30	785	2.10	1,595				

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904, and is well defined.

Estimated monthly discharge of Green River at Greenriver, Wyo., for 1904.

[Drainage area, 7,450 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	3,665	1,155	1,958	116,500	0.263	0.293
May	13,140	2,694	6,131	377,000	.823	.949
June	12,190	7,155	10,180	605,500	1.37	1.53
July	8,010	3,470	5,255	323,100	.705	.813
August	3,540	1,225	2,040	125,400	.274	.316
September	1,402	620	890	52,960	.119	.133
October	838	597	698	42,920	.094	.108
The period				1,643,000		

GREEN RIVER AT JENSEN, UTAH.

This station was established November 7, 1903, by H. S. Reed. It is located about 300 feet below Billings Ferry and about 15 miles from Vernal, Utah. It is 1½ miles below the mouth of Brush Creek and 3 miles above the mouth of Ashley Creek. The gage is a vertical 2 by 5 inch timber 10 feet long, braced to a cottonwood tree about 10 feet from the edge of the river. It is read twice each day by Victor Billings. This station was equipped with a cable and car during 1904, from which the measurement of August 8 was made. Those measurements made previous to August 8 were made from the ferryboat. The initial point for soundings is the first white mark on the cable on the right bank. The channel is straight for 1,000 feet above and below the station. The right bank is high, is composed of gravel, and will not overflow. The left bank is low and sandy and covered with underbrush. The bed of the stream is sandy and shifting. There is but one channel at all stages. Bench mark No. 1 is a 40-penny spike driven into the cottonwood tree to which the gage is attached. Its elevation is 10.66 feet above the zero of the gage. Bench mark No. 2 is a 40-penny spike driven into the southwest corner of Mr. Billings's grain house about 3 feet above the ground. Its elevation is 25.67 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Green River at Jensen, Utah, in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Feet per sec.*	*Feet.*	*Second-feet.*
November 10	H. S. Reed	654	2.22	2.45	1,453
1904.					
March 31	H. S. Reed	1,273	2.10	3.25	2,679
April 28	do	2,585	3.30	5.78	8,530
May 25	do	5,310	5.14	10.75	27,290
August 8[a]	do	1,670	1.83	3.45	3,059

[a] Made from cable and car.

Mean daily gage height, in feet, of Green River at Jensen, Utah, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			4.24	3.32	7.00	10.35	7.25	4.32	2.85	1.63	2.11	1.65
2			4.05	3.42	7.50	10.25	7.18	4.21	2.75	1.62	2.11	1.60
3			3.95	3.55	7.64	10.50	7.15	4.12	2.71	1.64	2.10	1.65
4			3.38	3.90	7.96	10.40	7.10	4.02	3.05	1.65	2.00	1.80
5			3.26	4.30	7.90	10.40	7.08	3.86	3.00	1.63	2.05	1.35
6			3.22	4.45	7.58	10.40	7.02	3.72	2.96	1.68	2.05	.98
7			3.05	4.45	7.82	9.68	7.00	3.58	2.85	2.08	1.99	1.08
8			3.00	4.41	8.02	9.58	7.00	3.48	2.72	1.79	1.88	1.20
9			3.06	4.48	8.35	9.45	6.90	3.40	2.64	1.71	1.65	1.36
10			3.10	4.35	8.02	9.60	6.90	3.36	2.45	1.72	1.68	1.41
11			3.16	4.18	7.65	10.10	6.80	3.33	2.35	1.60	1.58	1.45
12			3.50	4.02	7.68	9.95	6.38	3.30	2.20	1.61	1.55	1.50
13			3.78	4.14	7.89	10.05	6.06	3.26	2.04	1.69	1.48	1.45
14			3.82	4.72	7.96	10.28	5.95	3.18	2.01	1.88	1.60	1.45
15			3.65	5.40	8.10	10.20	5.90	3.08	2.00	2.20	1.50	1.50
16			3.69	5.85	8.52	10.12	5.80	3.10	1.96	2.58	1.60	1.45
17			3.81	6.10	8.68	10.02	5.70	3.40	1.93	2.70	1.60	1.60
18			3.82	6.55	8.98	9.98	5.70	3.40	1.89	2.58	1.55	1.62
19			3.78	6.68	9.01	9.92	5.60	3.45	1.82	2.42	1.55	1.65
20			3.66	6.78	9.12	9.70	5.60	3.50	1.72	2.40	1.50	1.71
21			3.72	6.84	9.60	9.90	5.54	3.50	1.66	2.36	1.50	1.79
22			4.92	6.88	10.00	9.82	5.50	3.45	1.61	2.34	1.55	1.94
23			4.58	6.92	10.30	9.72	5.47	3.42	1.69	2.28	1.65	2.00
24		2.83	4.52	6.95	10.65	9.60	5.41	3.41	1.69	2.19	1.56	1.95
25		3.10	4.35	6.52	10.82	9.50	5.40	3.40	1.68	2.15	1.50	[b]1.25
26		3.70	4.19	6.15	11.12	9.38	5.40	3.38	1.66	2.10	1.58	1.12
27		4.60	3.83	5.92	11.52	9.15	5.25	3.30	1.62	2.12	1.59	.96
28		4.38	3.22	5.75	11.65	8.85	5.15	3.24	1.60	2.12	1.61	2.60
29		4.31	3.21	5.92	11.80	8.28	4.85	3.20	1.60	2.06	1.60	.....
30			3.29	6.40	11.78	7.38	4.70	3.05	1.60	2.12	1.60	.....
31			3.28	.....	10.65	.....	4.55	2.98	.....	2.13	.....	.....

[a] River frozen over from January 1 to February 23. [b] River frozen over, December 25 to 31.

Rating table for Green River at Jensen, Utah, from November 7, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	400	2.60	1,660	4.30	4,800	7.00	12,380
1.25	430	2.70	1,805	4.40	5,040	7.20	13,060
1.30	460	2.80	1,955	4.50	5,280	7.40	13,740
1.35	495	2.90	2,110	4.60	5,520	7.60	14,440
1.40	530	3.00	2,270	4.70	5,760	7.80	15,160
1.45	565	3.10	2,430	4.80	6,000	8.00	15,890
1.50	600	3.20	2,600	4.90	6,240	8.20	16,650
1.60	670	3.30	2,780	5.00	6,480	8.40	17,410
1.70	740	3.40	2,960	5.20	7,000	8.60	18,200
1.80	820	3.50	3,140	5.40	7,520	8.80	19,000
1.90	900	3.60	3,320	5.60	8,080	9.00	19,800
2.00	980	3.70	3,520	5.80	8,640	9.50	21,900
2.10	1,070	3.80	3,720	6.00	9,200	10.00	24,000
2.20	1,170	3.90	3,920	6.20	9,800	10.50	26,200
2.30	1,280	4.00	4,140	6.40	10,440	11.00	28,400
2.40	1,400	4.10	4,360	6.60	11,080	11.50	30,700
2.50	1,525	4.20	4,580	6.80	11,720		

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 2.45 feet and 10.75 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Green River at Jensen, Utah, for 1903 and 1904.

[Drainage area, 26,620 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
November 7–30	1,564	852	1,292	61,500	0.049	0.044
December	2,834	1,388	1,726	106,100	.065	.075
1904.						
February 24–29	4,992	2,000	3,881	46,180	0.146	0.033
March	6,288	2,270	3,547	218,100	.133	.153
April	12,210	2,816	7,583	451,200	.285	.318
May	32,080	12,380	20,400	1,254,000	.766	.883
June	26,200	13,670	23,000	1,369,000	.864	.964
July	13,230	5,400	9,485	583,200	.356	.410
August	4,848	2,238	3,103	190,800	.117	.135
September	2,350	670	1,214	72,240	.046	.051
October	1,805	670	1,041	64,010	.039	.045
November	1,080	586	745	44,330	.028	.031
December 1–24	980	236	639	30,420	.024	.021
The period				4,323,000		

GREEN RIVER AT OURAY, UTAH.

This station was established March 23, 1904, by H. S. Reed. It is located about 500 feet below the ferry maintained by the Government at Ouray, Utah. The nearest town is Vernal, Utah, 35 miles distant, and the nearest railroad station is Price, Utah, 115 miles distant. A plain staff gage is attached vertically to a 4 by 6 inch timber, which is securely driven into the river bottom and spiked to various portions of a large cottonwood tree that overhangs the right bank. The gage is read twice each day by R. E. Waugh. Discharge measurements are made from the Government ferry cable, which is suspended across the river about 500 feet above the gage. The initial point for soundings is the first white mark on the cable on the right bank of the river. The channel is slightly curved for about 2,000 feet above and straight for 1,200 feet below the station, and there is a good velocity. Both banks are fairly high and timbered. The right bank overflows for a short distance at high stages. The bed of the stream is composed of clean sand, and is shifting. The stream is usually confined to one channel, only changing as sand bars are formed during high water. Bench mark No. 1 is a large nail driven into the inside face of the tree that supports the gage rod. Its elevation is 13.795 feet above the zero of the gage. Bench mark No. 2 is a large nail driven into a blaze on a root of one of a group of large cottonwood trees 150 feet northeast of the gage. Its elevation is 13.51 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Green River at Ouray, Utah, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec. feet.*
March 24	H. S. Reed	298	1,914	2.41	2.80	4,610
August 16	do	289	1,319	2.16	1.20	2,852
October 29	do	251	686	2.12	.25	1,457

Mean daily gage height, in feet, of Green River at Ouray, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.12	6.00	10.10	6.48	2.45	1.20	0.00	0.25	-0.30
2		1.22	6.40	9.98	6.10	2.25	1.00	.00	.20	.30
3		1.40	6.88	9.90	5.90	2.08	.95	−.10	.20	−.30
4		1.80	6.70	9.75	5.82	2.00	.85	−.10	.20	−.30
5		2.20	6.70	9.70	5.80	1.92	1.15	−.10	.10	−.40
6		2.20	6.42	9.62	5.75	1.82	1.10	−.10	.10	−.40
7		2.45	6.35	9.40	5.70	1.65	1.00	.00	.00	−.50
8		2.45	6.38	9.18	5.55	1.50	.85	.70	.00	−.50
9		2.40	6.50	9.15	5.38	1.32	.80	.30	.00	.10
10		2.40	7.00	8.90	5.30	1.25	.75	.10	.00	.00
11		2.12	6.58	9.45	5.20	1.20	.65	.00	.00	.00
12		1.90	6.52	9.80	4.95	1.15	.45	.00	.00	.25
13		2.22	7.00	9.72	4.70	1.22	.30	.10	.00	.40
14		2.78	7.40	9.85	4.42	1.38	.30	.15	.00	a.55
15		3.35	7.65	10.02	4.15	1.20	.26	.30	−.10	a.65
16		3.85	7.90	9.88	3.95	1.22	.15	.40	−.15	a.70
17		4.45	8.05	9.52	3.90	1.25	.00	.60	−.20	a.70
18		4.80	8.18	9.40	3.82	1.32	−.10	.70	−.20	a.70
19		5.15	8.48	9.38	3.65	1.48	−.10	.70	.20	a.70
20		5.30	8.75	9.32	3.42	1.62	−.10	.65	−.20	a.70
21		5.35	9.02	9.15	3.15	1.68	−.10	.50	−.20	a.70
22		5.55	9.35	9.05	2.92	1.48	−.05	.50	−.20	a.70
23	3.00	5.60	9.92	8.92	2.70	1.32	.00	.50	−.20	a.70
24	2.80	5.82	10.65	8.75	2.50	1.35	.00	.45	−.20	a.70
25	2.40	5.55	10.92	8.60	2.50	1.30	.00	.40	−.20	a.70
26	2.12	5.00	11.18	8.42	2.40	1.20	.00	.30	−.20	a.70
27	1.88	4.60	11.42	8.28	2.38	1.20	.00	.30	−.20	a.80
28	1.58	4.40	11.55	7.90	2.45	1.15	.00	.30	−.20	a.90
29	1.28	4.62	11.45	7.45	2.68	1.10	.00	.30	−.30	a.80
30	1.15	5.08	11.10	6.98	2.70	1.40	.00	.30	.35	a.60
31	1.22		10.52		2.65	1.45		.30		a.50

a Increased gage height due to back water from ice gorge below gaging station.

PINE CREEK NEAR PINEDALE, WYO.

This station was established April 25, 1904, by A. J. Parshall. It is located about one-fourth mile west of Pinedale, Wyo., and is reached from Opal, Wyo., a station on the Oregon Shortline Railroad, by stage from Opal to Cora, thence to Pinedale, a distance of 115 miles. The gage is a vertical 10-inch round timber hewn and planed smooth, graduated to feet and tenths, set 1 foot into the cobblestone bottom of the channel and braced firmly to a pine tree on the left bank. It is read each day by Mrs. Cecilie Petersen. There being no bridge upon the stream, discharge measurements are made by wading near the gage during ordinary discharge and by a boat 2 miles upstream during high water. The channel is straight for about 300 feet above and below the station, and the current is swift. The right bank is low, fringed with timber about 10 feet back from the bank, and is liable to overflow during extreme high water. The left bank is high, fringed with willows, and does not overflow. The bed of the stream is com-

posed of rock and clean gravel, and is permanent. The conditions are only fairly favorable for accuracy. The bench-mark at the gage is a notch cut into a pine tree a few feet south of the gage rod. Its elevation is 5.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Pine Creek River near Pinedale, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	A. J. Parshall	41	37	1.70	0.50	63
June 1	do	139	231	2.68	2.20	619
June 27	do	153	296	3.45	3.10	1,022
July 23	G. N. Stadin	110	264	2.12	2.10	560
August 16	A. J. Parshall	60	91	2.78	1.20	253
October 27	G. N. Stadin	35	27	1.52	.00	41

Mean daily gage height, in feet, of Pine Creek near Pinedale, Wyo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.60	2.10	3.00	1.80	0.90	0.60
2	.60	2.10	2.90	1.70	.90	.50
3	.60	2.00	2.90	1.60	.90	.50
4	.70	2.00	2.80	1.50	.90	.50
5	.80	2.00	2.80	1.40	.90	.50
6	.80	2.00	2.70	1.30	.80	.40
7	.80	2.00	2.70	1.20	.80	.40
8	.80	2.20	2.60	1.10	.80	.40
9	.80	2.40	2.60	1.00	.80	.30
10	.80	2.40	2.50	1.00	.70	.30
11	.80	2.50	2.40	1.00	.70	.20
12	.80	2.60	2.30	.90	.70	.20
13	.80	2.70	2.20	.90	.70	.20
14	.80	2.90	2.10	1.00	.70	.20
15	.80	3.00	2.00	1.00	.70	.20
16	.90	3.10	2.00	1.00	.70	.20
17	.90	3.20	2.20	1.10	.70	.00
18	1.00	3.30	2.20	1.10	.65	.00
19	1.00	3.40	2.10	1.20	.65	.00
20	1.10	3.50	2.10	1.20	.65	.00
21	1.10	3.60	2.10	1,10	.60	.00
22	1.20	3.60	2.10	1.10	.60	.00
23	1.20	3.70	2.00	1.10	.60	.00
24	1.20	3.60	2.10	1.10	.60	.00
25	1.30	3.50	2.20	1.10	.60	.00
26	2.00	3.40	2.20	1.00	.60	.00
27	2.20	3.00	2.10	1.00	.60	.00
28	2.00	3.10	2.00	1.00	.60	.00
29	2.00	2.90	2.00	1.00	.60	.00
30	2.00	3.10	1.90	1.00	.60	.00
31	2.00	.....	1.90	1.00	.....	.00

Rating table for Pine Creek near Pinedale, Wyo., from April 25 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	24	1.00	195	2.00	530	2.90	925
.10	30	1.10	223	2.10	570	3.00	975
.20	39	1.20	253	2.20	610	3.10	1,025
.30	51	1.30	284	2.30	650	3.20	1,075
.40	65	1.40	316	2.40	695	3.30	1,125
.50	81	1.50	348	2.50	740	3.40	1,175
.60	99	1.60	381	2.60	785	3.50	1,230
.70	119	1.70	415	2.70	830	3.60	1,285
.80	142	1.80	450	2.80	875	3.70	1,340
.90	168	1.90	490				

The above table is applicable only for open-channel conditions. It is based upon six discharge measurements made during 1904. It is fairly well defined between gage heights, 1.20 feet and 3.10 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Pine Creek near Pinedale, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	610	99	240	14,760
June	1,340	530	908	54,030
July	975	490	663	40,770
August	450	168	239	14,700
September	168	99	123	7,319
October	99	24	42.4	2,607
The period				134,200

POLE CREEK AT FAYETTE, WYO.

This station was established April 22, 1904, by A. J. Parshall. It is located about 300 yards west of the post-office at Fayette, Wyo., and is reached by stage from Opal, a station on the Oregon Shortline Railroad, about 125 miles distant, or by a private conveyance from Greenriver, a station on the Union Pacific Railroad, about equally distant. The gage is a vertical 9-inch timber, hewn and planed smooth, graduated to feet and tenths, set in the cobblestone bed of the stream and firmly braced to the left bank. It is read once each day by G. N. Stadin. Discharge measurements are made by wading at low and

ordinary stages, and by means of a boat at high stages of discharge. The measuring section is chosen according to the height of the water, there being no bridges over the stream. The channel is straight for about 50 feet above and 150 feet below the station, and the current is swift. The bed of the channel is very winding, there being no point along the stream where a straight channel can be selected. The right bank is low, covered with brush, and liable to overflow. The slope of the river bed is toward the left bank, which is high, clean, and does not overflow. There is but one channel at low water, and one main channel with a small slough on either side at high water. That on the right side carried no water at any time during 1904. Bench mark No. 1 is the top of a 3-inch stake driven firmly into the ground about 10 feet from the gage, and marked with a copper number "0." Its elevation is 4.47 feet above the zero of the gage. Bench mark No. 2 is the top of a similar stake, about 10 feet from the gage, and marked with a copper number "7." Its elevation is 5.02 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. G. Parshall, resident hydrographer.

Discharge measurements of Pole Creek at Fayette, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 24	A. J. Parshall	42	46	1.57	1.55	72
May 31	do	78	168	3.72	2.90	625
June 27 [a]	do	80	169	3.61	2.90	610
July 23	G. N. Stadin	76	100	2.05	2.20	205
August 15	A. J. Parshall	42	54	2.17	1.80	117
Do	do	40	48	1.93	1.70	93
October 27	G. N. Stadin	25	26	.62	1.10	16

[a] Measurement from wagon.

Mean daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.50	2.90	2.80	2.20	1.50	1.15
2	1.80	2.90	2.90	2.20	1.45	1.15
3	1.90	2.90	2.90	2.20	1.45	1.15
4	1.90	2.80	2.90	2.10	1.50	1.15
5	1.90	2.70	2.80	2.10	1.50	1.15
6	2.00	2.70	2.80	2.10	1.50	1.15
7	2.10	2.80	2.90	2.10	1.50	1.15
8	2.10	2.80	2.90	2.00	1.50	1.15
9	2.00	2.90	2.80	1.90	1.50	1.15
10	1.90	3.00	2.80	1.90	1.45	1.20
11	1.90	3.10	2.70	1.80	1.45	1.20
12	2.00	3.10	2.60	1.80	1.45	1.20
13	2.00	3.10	2.50	1.80	1.45	1.15
14	2.00	3.20	2.50	1.75	1.45	1.15
15	2.00	3.30	2.50	1.75	1.45	1.15
16	2.10	3.30	2.50	1.70	1.45	1.15
17	2.10	3.30	2.50	1.70	1.40	1.15
18	2.20	3.30	2.50	1.70	1.40	1.15
19	2.25	3.50	2.40	1.70	1.35	1.15
20	2.40	3.50	2.30	1.70	1.35	1.15
21	2.80	3.30	2.20	1.70	1.35	1.15
22	2.90	3.30	2.20	1.65	1.30	1.15
23	3.00	3.30	2.20	1.65	1.25	1.15
24	3.50	3.40	2.30	1.60	1.20	1.15
25	3.50	3.30	2.30	1.60	1.20	1.15
26	3.50	3.20	2.30	1.60	1.20	1.15
27	3.50	3.00	2.30	1.50	1.20	1.10
28	3.20	2.90	2.30	1.55	1.20	1.10
29	3.00	2.80	2.30	1.50	1.20	1.10
30	3.00	2.80	2.30	1.50	1.15	1.10
31	3.00	.....	2.20	1.50	.....	1.10

Rating table for Pole Creek at Fayette, Wyo., from April 22 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	16	1.80	113	2.50	325	3.20	915
1.20	27	1.90	133	2.60	380	3.30	1,015
1.30	39	2.00	154	2.70	445	3.40	1,115
1.40	51	2.10	177	2.80	525	3.50	1,215
1.50	64	2.20	205	2.90	615		
1.60	79	2.30	239	3.00	715		
1.70	95	2.40	279	3.10	815		

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined between gage heights 1.10 feet and 2.90 feet. The table has been extended above gage height 2.90 feet.

Estimated monthly discharge of Pole Creek at Fayette, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,215	64	418	25,700
June	1,215	445	799	47,540
July	615	205	371	22,810
August	205	64	116	7,133
September	64	22	48.8	2,904
October	27	16	21.5	1,322
The period				107,400

FALL CREEK NEAR FAYETTE, WYO.

This station was established April 22, 1904, by A. J. Parshall. It is located about 1¼ miles southeast of Fayette, Wyo., and is reached by stage from Opal, a station on the Oregon Short Line Railroad, about 125 miles distant, or by private conveyance from Greenriver, a station on the Union Pacific Railroad, about equally distant. The gage is a vertical 6-inch timber, hewn and planed smooth on one side, graduated to feet and tenths, set into the bed of the stream, and firmly braced to the left bank. It is read once each day by G. N. Stadin. Measurements are made at low and ordinary stages by wading, and at high water by means of a boat, the measuring section being chosen according to the height of the water. The initial point for soundings at the gage is the left bank. The channel is straight for about 40 feet above and 50 feet below the station. The current is sluggish above and swift below the section. Both banks are high and not liable to overflow. The bed of the stream is composed of clean gravel and sand, that portion near the right bank being covered only during high water. There is but one channel at all stages. The conditions are favorable for accuracy. The bench mark is a cross on the highest point of a stone about 1 foot in diameter, planted firmly in the ground 10 feet from the gage and surrounded by smaller stones. Its elevation is 4.63 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Fall Creek near Fayette, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 24	A. J. Parshall	18	22	1.14	1.50	25
May 30	do	45	73	3.67	2.50	268
June 27	do	42	59	3.22	2.30	190
July 24	do	35	35	2.00	1.80	70
August 15	do	34	27	.88	1.50	24

Mean daily gage height, in feet, of Fall Creek near Fayette, Wyo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.50	2.60	2.10	1.80	1.40	1.25
2	1.50	2.50	2.20	1.80	1.35	1.25
3	1.60	2.50	2.20	1.80	1.30	1.25
4	1.65	2.50	2.20	1.80	1.30	1.25
5	1.65	2.40	2.20	1.70	1.30	1.25
6	1.80	2.30	2.25	1.70	1.30	1.25
7	2.00	2.30	2.20	1.60	1.30	1.25
8	2.00	2.40	2.20	1.60	1.30	1.25
9	2.00	2.50	2.20	1.60	1.30	1.25
10	2.00	2.60	2.20	1.50	1.30	1.25
11	2.10	2.70	2.00	1.50	1.25	1.25
12	2.00	2.70	1.90	1.50	1.25	1.25
13	2.00	2.70	1.90	1.50	1.25	1.25
14	2.00	2.70	1.90	1.50	1.25	1.25
15	2.00	2.70	1.80	1.50	1.25	1.25
16	2.15	2.80	1.70	1.50	1.25	1.25
17	2.20	2.90	1.70	1.40	1.25	1.25
18	2.20	2.90	1.70	1.45	1.25	1.25
19	2.20	3.00	1.70	1.45	1.25	1.25
20	2.30	3.00	1.70	1.45	1.25	1.25
21	2.40	3.00	1.70	1.50	1.25	1.25
22	2.50	2.70	1.70	1.50	1.25	1.25
23	2.70	2.70	1.80	1.50	1.25	1.25
24	2.90	2.80	1.80	1.50	1.25	1.25
25	2.90	2.50	1.80	1.50	1.25	1.25
26	3.00	2.40	1.80	1.40	1.25	1.25
27	3.00	2.30	1.80	1.40	1.25	1.25
28	2.50	2.20	1.80	1.40	1.25	1.25
29	2.50	2.10	1.80	1.40	1.25	1.25
30	2.50	2.10	1.80	1.40	1.25	1.25
31	2.60	.....	1.80	1.40	.....	1.25

Rating table for Fall Creek near Fayette, Wyo., from April 24 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.25	7	1.60	36	1.95	101	2.50	263
1.30	9	1.65	43	2.00	113	2.60	300
1.35	12	1.70	51	2.10	138	2.70	340
1.40	16	1.75	60	2.20	165	2.80	385
1.45	20	1.80	70	2.30	195	2.90	430
1.50	25	1.85	80	2.40	228	3.00	480
1.55	30	1.90	90				

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is well defined between gage heights 1.50 feet and 2.50 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Fall Creek near Fayette, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	480	25	189	11,620
June	480	138	302	17,970
July	180	51	99.3	6,106
August	70	16	31.0	1,906
September	16	7	8.0	476
October	7	7	7.0	430
The period				38,510

BOULDER CREEK NEAR NEWFORK, WYO.

This station was established April 23, 1904, by A. J. Parshall. It is located at the Coolidge ranch, about 3½ miles northeast of Newfork, Wyo., and is reached by private conveyance from Greenriver, a station on the Union Pacific Railroad, about 120 miles distant, or by stage from Opal, a station on the Oregon Short Line Railroad, about equally distant. The gage is a vertical 10-inch timber, hewn and planed smooth on one side, graduated to feet and tenths, firmly set in the bed of the stream, and braced to a tree and stump on the left bank. It is read twice each day by T. J. Coolidge. Discharge measurements are made by wading at ordinary and by means of a boat at high stages, the location of the measuring section depending upon the height of the water. The channel is straight for about 300 feet above and below the station and the current is swift. The right bank is low, covered with brush and spruce trees a few feet back from the bank, and the left bank is high. Neither bank is liable to overflow. The bed of the stream is composed of rock and clean gravel and is

permanent. There is but one channel at all stages. The bench mark is a spike driven into a stump 3 feet from the gage. Its elevation is 4.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

Discharge measurements of Boulder Creek near Newfork, Wyo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
April 23	A. J. Parshall	64	68	1.12	0.65	76
May 31[a]	do	90	222	4.68	3.30	1,05[illegible]
June 26[b]	do	80	320	4.17	3.30	1,335
July 6	G. N. Stadin	88	231	4.09	3.00	945
July 18	do	90	191	2.46	2.10	470
August 14	A. J. Parshall	60	107	1.42	1.00	152
August 20	do	63	107	1.22	.90	131
October 28	G. N. Stadin	40	42	.45	.30	19

[a] Measurement made from wagon.
[b] Measurement made from boat.

Mean daily gage height, in feet, of Boulder Creek near Newfork, Wyo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.90	3.50	3.40	1.48	0.70	0.[illegible]
2	.90	3.50	3.30	1.35	.70	.[illegible]
3	.90	3.30	2.95	1.30	.70	.[illegible]
4	1.00	2.85	2.80	1.28	.70	.[illegible]
5	1.00	2.65	2.90	1.20	.68	.[illegible]
6	1.00	2.68	3.00	1.12	.65	.[illegible]
7	1.00	3.15	2.85	1.10	.62	.[illegible]
8	1.00	3.68	2.68	1.08	.60	.[illegible]
9	1.00	3.60	2.70	1.05	.60	.[illegible]
10	1.00	3.68	2.62	1.02	.55	.[illegible]
11	1.00	3.92	2.60	1.00	.50	.[illegible]
12	1.00	3.88	2.60	1.00	.50	.[illegible]
13	1.10	3.82	2.60	1.00	.50	.[illegible]
14	1.18	3.92	2.55	.95	.50	.[illegible]
15	1.28	4.28	2.35	.95	.50	.[illegible]
16	1.42	4.35	2.20	.95	.45	.[illegible]
17	1.58	4.32	2.15	.95	.45	.[illegible]
18	1.75	4.25	2.02	.90	.42	.[illegible]
19	2.10	4.20	1.90	.90	.40	.[illegible]
20	2.55	4.30	1.85	.80	.40	.[illegible]
21	2.80	4.40	1.88	.80	.40	.[illegible]
22	2.52	4.40	1.90	.80	.40	.[illegible]
23	3.05	4.35	1.90	.80	.40	.[illegible]
24	3.60	4.05	1.95	.78	.40	.[illegible]
25	3.95	3.68	2.08	.75	.35	.[illegible]
26	3.70	3.20	2.00	.70	.35	.[illegible]
27	3.20	2.98	1.85	.70	.35	.[illegible]
28	2.90	2.98	1.75	.70	.35	.[illegible]
29	2.90	3.15	1.65	.70	.35	.[illegible]
30	3.15	3.35	1.60	.70	.35	.[illegible]
31	3.30	.....	1.58	.70	.....	.[illegible]

Rating table for Boulder Creek near Newfork, Wyo., from April 23 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	19	0.95	137	2.10	470	3.30	1,260
.35	27	1.00	148	2.20	515	3.40	1,355
.40	35	1.10	171	2.30	560	3.50	1,450
.45	43	1.20	195	2.40	610	3.60	1,550
.50	51	1.30	219	2.50	665	3.70	1,650
.55	59	1.40	244	2.60	725	3.80	1,755
.60	67	1.50	271	2.70	790	3.90	1,860
.65	76	1.60	300	2.80	860	4.00	1,970
.70	85	1.70	330	2.90	930	4.10	2,080
.75	95	1.80	360	3.00	1,005	4.20	2,190
.80	105	1.90	395	3.10	1,085	4.30	2,305
.85	115	2.00	430	3.20	1,170	4.40	2,420
.90	126						

The above table is applicable only for open-channel conditions. It is based upon eight discharge measurements made during 1904. It is well defined between gage heights 0.30 foot and 3.00 feet. The table has been extended above 3.30 feet gage height.

Estimated monthly discharge of Boulder Creek near Newfork, Wyo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,915	126	563	34,620
June	2,420	758	1,669	99,310
July	1,355	294	625	38,430
August	266	85	139	8,547
September	85	27	50.4	2,999
October	27	19	20.0	1,230
The period				185,100

Estimated monthly discharge of Elk River near Trull, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 2–31	3,485	1,502	2,185	130,000
June	2,430	1,206	1,749	104,100
July	1,129	260	539	33,140
August	294	97	185	11,380
September	213	80	110	6,545
October	184	97	137	8,424
The period				293,600

WILLIAMS RIVER AT HAMILTON, COLO.

This station was established April 29, 1904, by Oro McDermith. It is located at the highway bridge at Hamilton, on the stage road from Meeker to Craig, Colo., and about 17 miles from the latter place. The gage is a 2 by 4 inch by 14 foot timber driven vertically into the bottom of the river with the upper end fastened to the lower side of the bridge. It is read morning and evening by Mrs. Thomas Hamilton. Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is the vertical log abutment at the left end of the bridge on the downstream side. The channel is straight for about 150 feet above and for 100 feet below the station. The current is swift. The right bank is high, rocky, clean, and is not subject to overflow. The left bank is low and wooded, and does not overflow except during extreme high water. The bed of the stream is composed of rocks and gravel, and is permanent. There is but one channel at all stages. A reef of rocks extends into the stream for about 10 feet on the right bank just above the station. Bench mark No. 1 is a nail driven into the top log at the northeast corner of the left abutment of the bridge. Its elevation is 12.22 feet above the zero of the gage. Bench mark No. 2 is the head of a nail driven into a root on the west side of a small cottonwood tree about 25 feet from the left end of the bridge and just east of the road. Its elevation is 10.08 feet above the zero of the gage. Bench mark No. 3 is a nail driven into the southeast corner of the foundation of the blacksmith shop about 25 feet from the left end of the bridge. Its elevation is 10.08 feet above the zero of the gage. Bench mark No. 4 is a United States Geological Survey standard iron bench mark at the southeast corner of the wagon bridge at Hamilton. Its elevation is 10.77 feet above the zero of the gage.

Mean daily gage height, in feet, of Yampa River at Steamboat Springs, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.60	4.90	3.30	3.40	3.30
2	.....	6.42	4.65	3.30	3.45	3.28
3	5.25	6.65	4.35	3.30	3.42	3.30
4	5.18	6.15	4.30	3.30	3.40	3.30
5	5.35	6.05	4.28	3.32	3.38	3.32
6	5.15	5.95	4.30	3.30	3.32	3.30
7	5.55	6.05	4.10	3.30	3.30	3.32
8	5.25	5.98	4.02	3.30	3.30	3.48
9	5.10	5.85	3.85	3.30	3.30	3.50
10	5.12	5.95	3.68	3.30	3.30	3.30
11	5.30	5.85	3.65	3.40	3.30	3.38
12	5.35	5.98	3.50	3.55	3.30	3.40
13	5.55	5.75	3.65	3.32	3.30	3.40
14	5.90	5.95	3.42	3.30	3.30	3.40
15	6.20	6.05	3.38	3.32	3.30	3.38
16	5.95	5.95	3.30	3.30	3.30	3.40
17	6.02	5.90	3.30	3.30	3.30	3.42
18	6.12	5.92	3.30	3.32	3.30	3.38
19	6.45	5.85	3.32	3.30	3.30	3.42
20	6.75	6.00	3.30	3.48	3.30	3.45
21	6.70	5.70	3.42	3.40	3.30	3.45
22	6.80	5.75	3.35	3.40	3.32	3.40
23	6.75	5.55	3.28	3.42	3.30	3.40
24	7.15	5.42	3.42	3.45	3.30	3.40
25	7.40	5.45	3.28	3.45	3.32	3.40
26	7.18	5.15	3.30	3.52	3.45	3.38
27	7.05	4.98	3.32	3.60	3.38	3.40
28	6.80	4.85	3.30	3.55	3.35	3.38
29	7.05	4.82	3.30	3.48	3.30	3.40
30	6.90	5.20	3.30	3.42	3.30	3.42
31	6.75	.....	3.42	3.40	.....	3.40

Rating table for Yampa River at Steamboat Springs, Colo., from May 3 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	130	3.90	350	5.00	935	6.10	1,840
3.25	137	4.00	395	5.10	1,000	6.20	1,940
3.30	146	4.10	440	5.20	1,070	6.30	2,045
3.35	157	4.20	485	5.30	1,145	6.40	2,150
3.40	170	4.30	530	5.40	1,220	6.50	2,260
3.45	185	4.40	580	5.50	1,300	6.60	2,370
3.50	200	4.50	630	5.60	1,380	6.80	2,610
3.55	216	4.60	685	5.70	1,465	7.00	2,850
3.60	232	4.70	745	5.80	1,550	7.20	3,110
3.70	268	4.80	805	5.90	1,640	7.40	3,400
3.80	307	4.90	870	6.00	1,740		

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904, and is fairly well defined. The table has been extended above 6.50 feet gage height.

Estimated monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904.

Month.	Discharge in second feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 3–31	3,400	1,000	1,967	113,1
June	2,430	818	1,575	93,7
July	870	142	278	17,0
August	232	146	166	10,2
September	185	146	153	9,1
October	200	142	166	10,2
The period				253,4

YAMPA RIVER NEAR CRAIG, COLO.

This station was established April 30, 1904, by Oro McDermith. It is located on the wagon bridge 1 mile south of Craig, on the road to Meeker, Colo. The gage is a vertical 2 by 4 inch timber 12 feet long, fastened to a pile of the old log abutment at the left end of the bridge. It is graduated to feet and tenths, the numbers being painted on the rod. The gage is read morning and evening by Martin Earley. Discharge measurements are made from the downstream side of the three-span, tubular steel pier bridge to which the gage is attached. The initial point for soundings is the vertical wall of the old log abutment to which the gage is attached. The channel is straight for about 250 feet above and for 300 feet below the station. The current is swift at high, and very sluggish at low stages. Both banks are low and liable to overflow at very high stages, the right through two and the left through one culvert in the road grade. The bed of the stream is composed of gravel, cobblestones, and sand and is permanent. There is one channel at all stages divided by the two piers of the bridge, with the exception of the overflow at extreme high water through the culverts mentioned above. At high water there is always a quantity of driftwood on the piers. Bench mark No. 1 is the top of a bolt marked with a cross on the top of the tubular steel and concrete pier which forms part of the left abutment on the downstream side of the bridge. Its elevation is 14.339 feet above the zero of the gage. Bench mark No. 2 is the top of a bolt marked with a cross on the top of the corresponding pier on the upstream side of the bridge. Its elevation is 14.369 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Yampa River near Craig, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 30	O. McDermith	185	1,080	3.94	5.90	4,256
May 21	do	203	1,358	5.15	7.37	6,995
June 15	do	190	1,154	4.64	6.58	5,347
June 23	do	180	923	3.32	5.25	3,061
July 22	do	133	500	.74	2.53	369
July 27	do	130	489	.62	2.46	304
August 21	do	130	493	.65	2.47	320
September 2	do	133	476	.65	2.42	308

Mean daily gage height, in feet, of Yampa River near Craig, Colo., for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	6.15	6.65	4.28	2.45	2.40	2.00
2	6.10	6.28	4.18	2.45	2.40	2.00
3	5.85	6.40	4.12	2.45	2.40	2.00
4	5.65	6.22	4.02	2.45	2.40	2.00
5	5.52	6.65	3.62	2.45	2.38	2.00
6	5.50	5.55	3.72	2.45	2.32	2.00
7	6.00	5.55	3.68	2.45	2.30	2.00
8	5.75	5.78	3.52	2.45	2.30	2.00
9	5.65	6.38	3.50	2.45	2.25	2.00
10	5.58	6.20	3.40	2.42	2.22	2.00
11	5.95	6.65	3.35	2.40	2.18	2.00
12	6.05	6.75	3.25	2.40	2.15	2.05
13	6.25	6.80	3.10	2.40	2.00	2.30
14	6.55	6.70	3.02	2.40	2.00	2.35
15	6.42	6.45	2.95	2.40	2.00	2.40
16	6.35	6.30	2.88	2.32	2.00	2.40
17	6.30	6.08	2.82	2.30	2.00	2.40
18	6.35	5.68	2.80	2.25	2.00	2.40
19	6.55	5.40	2.75	2.60	2.00	2.35
20	7.05	5.72	2.68	2.55	2.00	2.35
21	7.20	5.62	2.45	2.45	2.00	2.35
22	7.25	5.55	2.50	2.45	2.00	2.35
23	7.30	5.38	2.50	2.40	2.00	2.35
24	7.55	5.35	2.50	2.40	2.00	2.35
25	7.62	5.05	2.45	2.40	2.00	2.35
26	7.55	4.92	2.50	2.40	2.00	2.35
27	7.08	4.78	2.48	2.40	2.00	2.30
28	7.10	4.65	2.45	2.40	2.00	2.30
29	7.05	4.45	2.45	2.40	2.00	2.30
30	7.12	4.40	2.45	2.40	2.00	2.30
31	7.00	.....	2.45	2.40	.....	2.30

Rating table for Yampa River near Craig, Colo., from April 30 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	163	3.40	920	4.80	2,470	6.10	4,480
2.10	190	3.50	1,010	4.90	2,610	6.20	4,660
2.20	221	3.60	1,100	5.00	2,750	6.30	4,840
2.30	255	3.70	1,200	5.10	2,890	6.40	5,020
2.40	291	3.80	1,300	5.20	3,030	6.50	5,220
2.50	330	3.90	1,400	5.30	3,175	6.60	5,420
2.60	375	4.00	1,500	5.40	3,325	6.70	5,620
2.70	430	4.10	1,610	5.50	3,475	6.80	5,820
2.80	490	4.20	1,720	5.60	3,630	6.90	6,020
2.90	555	4.30	1,840	5.70	3,790	7.00	6,220
3.00	625	4.40	1,960	5.80	3,955	7.20	6,630
3.10	695	4.50	2,080	5.90	4,125	7.40	7,070
3.20	765	4.60	2,210	6.00	4,300	7.60	7,510
3.30	840	4.70	2,340				

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 5.25 feet and 7.40 feet. Below 5.25 feet the curve is determined by 4 measurements between gage heights 2.42 feet and 2.53 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Yampa River near Craig, Colo., for 1904.

[Drainage area, 1,730 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	7,554	3,475	5,281	324,700	3.05	3.52
June	5,820	1,960	4,011	238,700	2.32	2.59
July	1,816	310	731	44,950	.423	.487
August	375	238	299	18,380	.173	.199
September	291	163	201	11,960	.116	.130
October	291	163	230	14,140	.133	.153
The period				652,800		

YAMPA RIVER NEAR MAYBELL, COLO.

This station was established April 17, 1904, by Oro McDermith. It is located at the Thornburgh bridge, 10 miles west of Maybell and 75 miles from Meeker, Colo. A plain staff gage is fastened to the left downstream edge of the central masonry pier. It is read twice each day by Peter Farrell. Discharge measurements are made from the downstream side of the two-span highway bridge to which the gage is attached. The bridge has masonry abutments. The initial point for soundings is the edge of the left abutment. The channel is straight for about 300 feet above and 600 feet below the station. The current is swift, but at low water becomes sluggish above the station. The right bank is high, rocky, clean, and is not subject to overflow. The left bank is low, clean, and everflows during high water. The bed of the stream is composed of gravel and sand, and is shifting. There is but one channel at all stages, broken by the middle pier of the bridge. The bench mark is a United States Geological Survey standard bronze tablet set in the top stone of the right abutment on the downstream side. Its elevation is 10.79 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Yampa River near Maybell, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 17	O. McDermith	215	1,066	3.17	3.70	3,378
June 7	do	217	1,127	3.41	4.15	3,848
July 17	do	195	538	1.36	1.40	729
August 18	do	190	505	.81	.92	410

Mean daily gage height, in feet, of Yampa River near Maybell, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.00	5.80	2.80	0.80	0.85	0.20	0.50
2	.....	4.50	5.80	2.80	.85	.80	.25	.40
3	.....	4.65	5.25	2.85	.75	.75	.25	.50
4	.....	4.40	5.15	2.80	.85	.70	.30	.30
5	.....	4.15	5.15	2.75	.80	.80	.30	.3.
6	.....	4.15	4.70	2.45	.70	.75	.45	.....
7	.....	4.50	4.25	2.10	.60	.65	.35	.....
8	.....	4.10	4.40	2.00	.60	.60	.30	.....
9	.....	3.95	4.25	2.05	.60	.45	.35	.....
10	.....	4.25	4.40	1.90	.65	.50	.35	.....
11	.....	4.25	4.05	1.85	.60	.35	.25	.....
12	.....	4.85	5.10	1.95	.50	.40	.20	.....
13	.....	4.90	5.25	1.80	.50	.30	.40	.....
14	.....	5.15	5.20	1.60	.40	.30	.60	.....
15	.....	4.75	5.20	1.35	.60	.25	.65	.....
16	.....	4.85	5.00	1.35	.65	.40	.70	.....
17	3.70	5.00	4.80	1.35	.55	.45	.65	.....
18	3.85	4.95	4.65	1.30	.50	.40	.65	.....
19	4.05	5.10	4.15	1.20	.60	.45	.75	.....
20	4.50	5.10	4.15	1.05	.65	.45	.80	.....
21	4.65	5.25	4.10	.95	.65	.40	.75	.....
22	5.15	5.30	4.10	.90	.70	.30	.70	.....
23	4.25	5.55	4.55	.75	.80	.35	.65	.....
24	3.85	5.45	4.15	.70	.75	.30	.75	.....
25	3.65	5.60	4.10	.90	.65	.20	.80	.....
26	3.30	5.40	4.10	.85	.80	.25	.80	.....
27	3.65	6.05	4.25	.80	.90	.25	.75	.....
28	4.20	6.50	3.22	.70	.80	.20	.70	.....
29	4.90	5.55	3.05	.80	.90	.20	.60	.....
30	3.95	5.35	2.95	.65	.90	.20	.65	.....
31	.....	5.55	.....	.75	.85	.....	.50	.....

Rating table for Yampa River near Maybell, Colo., from April 17 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	195	1.50	800	2.80	2,050	4.00	3,730
.30	220	1.60	870	2.90	2,170	4.20	4,050
.40	250	1.70	950	3.00	2,300	4.40	4,370
.50	285	1.80	1,030	3.10	2,430	4.60	4,690
.60	320	1.90	1,110	3.20	2,560	4.80	5,010
.70	360	2.00	1,200	3.30	2,700	5.00	5,330
.80	405	2.10	1,290	3.40	2,840	5.20	5,650
.90	450	2.20	1,390	3.50	2,980	5.40	5,970
1.00	500	2.30	1,490	3.60	3,120	5.60	6,290
1.10	550	2.40	1,590	3.70	3,270	5.80	6,610
1.20	610	2.50	1,700	3.80	3,420	6.00	6,930
1.30	670	2.60	1,810	3.90	3,570	6.50	7,730
1.40	730	2.70	1,930				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is not well defined. The table has been extended above gage height 4.15 and below gage height 0.92 feet. Above gage height 3.90 feet the rating curve is a tangent, the difference being 160 per tenth.

Estimated monthly discharge of Yampa River near Maybell, Colo., for 1904.

[Drainage area, 3,670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 17–30	5,570	2,700	3,931	109,200	1.07	0.560
May	7,730	3,650	5,232	321,700	1.42	1.64
June	6,610	2,235	4,559	271,300	1.24	1.39
July	2,110	340	942	57,920	.257	.296
August	450	250	360	22,140	.098	.113
September	428	195	271	16,130	.074	.083
October	405	195	301	18,510	.082	.095
The period				816,900		

Rating table for Williams River at Hamilton, Colo., from April 29 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	21	3.10	143	3.90	360	5.10	820
2.55	30	3.15	155	4.00	390	5.20	870
2.60	39	3.20	167	4.10	420	5.30	920
2.65	49	3.25	179	4.20	450	5.40	970
2.70	59	3.30	192	4.30	485	5.50	1,020
2.75	69	3.35	205	4.40	525	5.60	1,070
2.80	79	3.40	218	4.50	565	5.70	1,130
2.85	89	3.45	232	4.60	605	5.80	1,190
2.90	99	3.50	246	4.70	645	5.90	1,250
2.95	110	3.60	274	4.80	685	6.00	1,310
3.00	121	3.70	302	4.90	725	6.10	1,370
3.05	132	3.80	330	5.00	770		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined. The table has been extended above gage height 5.80 feet and below gage height 2.80 feet.

Estimated monthly discharge of Williams River at Hamilton, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,370	685	1,003	61,670
June	970	345	667	39,690
July	330	75	166	10,210
August	148	59	87	5,349
September	148	21	60	3,570
October	95	39	61	3,751
The period				126,000

MILK CREEK NEAR AXIAL, COLO.

This station was established April 20, 1904, by Oro McDermith. It is located at the highway bridge about 4 miles below Axial, Colo. The gage is a vertical plain staff gage, graduated by feet and tenths to 10 feet, driven 2 feet into the sandy bed of the stream, the top being nailed to the bridge timbers. It is read once each day by O. M. Hoback. Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is at the left end of the bridge at the water's edge on the downstream side. The channel is straight for about 75 feet above and 50 feet below the station, and the current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of sand and is shifting. There is but one channel at all stages. There is a sunken log at the right bank, which slightly affects the measurements. Bench mark No. 1 is a nail driven into the east side of a telephone pole 25 feet south of the bridge. It is about 4 inches above the ground, and its elevation is 10.961 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the north side of a 12-inch pile at the northeast corner of the bridge. Its elevation is 10.080 feet above the zero of the gage. Bench mark No. 3, established July 21, 1904, is a United States Geological Survey standard iron bench-mark post, located about 50 feet southeast of the gage rod. Its elevation is 12.334 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Milk Creek near Axial, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 20	O. McDermith	23	74	2.35	5.78	174
May 22	do	20	60	2.22	5.27	133
June 14	do	18	26	1.69	4.00	44
June 24	do	17	16	1.06	3.65	17
July 21	do	8	3.9	.46	3.23	1.8

Rating table for Williams River at Hamilton, Colo., from April 29 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	21	3.10	143	3.90	360	5.10	820
2.55	30	3.15	155	4.00	390	5.20	870
2.60	39	3.20	167	4.10	420	5.30	920
2.65	49	3.25	179	4.20	450	5.40	970
2.70	59	3.30	192	4.30	485	5.50	1,020
2.75	69	3.35	205	4.40	525	5.60	1,070
2.80	79	3.40	218	4.50	565	5.70	1,130
2.85	89	3.45	232	4.60	605	5.80	1,190
2.90	99	3.50	246	4.70	645	5.90	1,250
2.95	110	3.60	274	4.80	685	6.00	1,310
3.00	121	3.70	302	4.90	725	6.10	1,370
3.05	132	3.80	330	5.00	770		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined. The table has been extended above gage height 5.80 feet and below gage height 2.80 feet.

Estimated monthly discharge of Williams River at Hamilton, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,370	685	1,003	61,670
June	970	345	667	39,690
July	330	75	166	10,210
August	148	59	87	5,349
September	148	21	60	3,570
October	95	39	61	3,751
The period				126,000

MILK CREEK NEAR AXIAL, COLO.

This station was established April 20, 1904, by Oro McDermith. It is located at the highway bridge about 4 miles below Axial, Colo. The gage is a vertical plain staff gage, graduated by feet and tenths to 10 feet, driven 2 feet into the sandy bed of the stream, the top being nailed to the bridge timbers. It is read once each day by O. M. Hoback. Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is at the left end of the bridge at the water's edge on the downstream side. The channel is straight for about 75 feet above and 50 feet below the station, and the current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of sand and is shifting. There is but one channel at all stages. There is a sunken log at the right bank, which slightly affects the measurements. Bench mark No. 1 is a nail driven into the east side of a telephone pole 25 feet south of the bridge. It is about 4 inches above the ground, and its elevation is 10.961 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the north side of a 12-inch pile at the northeast corner of the bridge. Its elevation is 10.080 feet above the zero of the gage. Bench mark No. 3, established July 21, 1904, is a United States Geological Survey standard iron bench-mark post, located about 50 feet southeast of the gage rod. Its elevation is 12.334 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Milk Creek near Axial, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 20	O. McDermith	23	74	2.35	5.78	174
May 22	do	20	60	2.22	5.27	133
June 14	do	18	26	1.69	4.00	44
June 24	do	17	16	1.06	3.65	17
July 21	do	8	3.9	.46	3.23	1.8

Rating table for Williams River at Hamilton, Colo., from April 29 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	21	3.10	143	3.90	360	5.10	820
2.55	30	3.15	155	4.00	390	5.20	870
2.60	39	3.20	167	4.10	420	5.30	920
2.65	49	3.25	179	4.20	450	5.40	970
2.70	59	3.30	192	4.30	485	5.50	1,020
2.75	69	3.35	205	4.40	525	5.60	1,070
2.80	79	3.40	218	4.50	565	5.70	1,130
2.85	89	3.45	232	4.60	605	5.80	1,190
2.90	99	3.50	246	4.70	645	5.90	1,250
2.95	110	3.60	274	4.80	685	6.00	1,310
3.00	121	3.70	302	4.90	725	6.10	1,370
3.05	132	3.80	330	5.00	770		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined. The table has been extended above gage height 5.80 feet and below gage height 2.80 feet.

Estimated monthly discharge of Williams River at Hamilton, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,370	685	1,003	61,670
June	970	345	667	39,690
July	330	75	166	10,210
August	148	59	87	5,349
September	148	21	60	3,570
October	95	39	61	3,751
The period				126,000

MILK CREEK NEAR AXIAL, COLO.

This station was established April 20, 1904, by Oro McDermith. It is located at the highway bridge about 4 miles below Axial, Colo. The gage is a vertical plain staff gage, graduated by feet and tenths to 10 feet, driven 2 feet into the sandy bed of the stream, the top being nailed to the bridge timbers. It is read once each day by O. M. Hoback. Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is at the left end of the bridge at the water's edge on the downstream side. The channel is straight for about 75 feet above and 50 feet below the station, and the current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of sand and is shifting. There is but one channel at all stages. There is a sunken log at the right bank, which slightly affects the measurements. Bench mark No. 1 is a nail driven into the east side of a telephone pole 25 feet south of the bridge. It is about 4 inches above the ground, and its elevation is 10.961 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the north side of a 12-inch pile at the northeast corner of the bridge. Its elevation is 10.080 feet above the zero of the gage. Bench mark No. 3, established July 21, 1904, is a United States Geological Survey standard iron bench-mark post, located about 50 feet southeast of the gage rod. Its elevation is 12.334 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Milk Creek near Axial, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 20	O. McDermith	23	74	2.35	5.78	174
May 22	do	20	60	2.22	5.27	133
June 14	do	18	26	1.69	4.00	44
June 24	do	17	16	1.06	3.65	17
July 21	do	8	3.9	.46	3.23	1.8

Mean daily gage height, in feet, of Milk Creek near Axial, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.30	4.40	3.40	3.20	3.50	[illegible]
2	.....	6.00	4.30	3.40	3.20	3.45	[illegible]
3	.....	5.80	4.80	3.40	3.20	3.30	[illegible]
4	.....	5.40	4.70	3.35	3.20	3.25	[illegible]
5	.....	5.60	4.50	3.30	3.20	3.25	[illegible]
6	.....	5.60	4.40	3.30	3.20	3.20	[illegible]
7	.....	6.20	4.40	3.30	3.20	3.20	[illegible]
8	.....	5.70	4.35	3.30	3.20	3.20	[illegible]
9	.....	5.40	5.10	3.30	3.20	3.20	[illegible]
10	.....	5.70	4.60	3.30	3.20	3.20	[illegible]
11	.....	6.00	4.50	3.30	3.20	3.20	[illegible]
12	.....	6.20	4.50	3.25	3.20	3.15	[illegible]
13	.....	6.30	4.45	3.25	3.20	3.15	[illegible]
14	.....	6.30	4.35	3.25	3.20	3.15	[illegible]
15	.....	6.25	4.30	3.25	3.42	3.15	[illegible]
16	.....	6.00	4.00	3.20	3.20	3.15	[illegible]
17	.....	5.90	3.80	3.25	4.65	3.20	[illegible]
18	.....	5.70	4.60	3.25	3.60	3.20	[illegible]
19	.....	6.10	5.40	3.25	3.40	3.25	[illegible]
20	5.88	5.50	4.00	3.25	3.35	3.25	[illegible]
21	6.45	5.25	3.80	3.25	3.35	3.20	[illegible]
22	5.60	5.25	a3.70	3.25	3.35	3.30	[illegible]
23	5.50	5.20	a3.65	3.25	3.35	3.35	[illegible]
24	5.30	5.10	a3.60	3.25	3.35	3.40	[illegible]
25	4.90	5.05	a3.55	3.25	3.35	3.40	[illegible]
26	5.35	5.00	3.50	3.20	3.30	3.60	[illegible]
27	5.70	4.95	3.50	3.20	3.30	3.50	[illegible]
28	6.35	4.85	3.50	3.20	3.30	3.50	[illegible]
29	6.50	4.75	3.45	3.20	3.30	3.40	[illegible]
30	6.40	4.60	3.45	3.25	3.30	3.40	[illegible]
31	.....	4.50	.....	3.25	3.08	.....	[illegible]

a Estimated.

Rating table for Milk Creek near Axial, Colo., from April 20 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.15	1	3.70	23	4.50	76	5.60	159
3.20	2	3.75	26	4.60	83	5.70	167
3.25	3	3.80	29	4.70	90	5.80	175
3.30	4	3.85	32	4.80	97	5.90	183
3.35	6	3.90	35	4.90	104	6.00	191
3.40	8	3.95	38	5.00	111	6.10	200
3.45	10	4.00	41	5.10	119	6.20	209
3.50	12	4.10	48	5.20	127	6.30	218
3.55	14	4.20	55	5.30	135	6.40	227
3.60	17	4.30	62	5.40	143	6.50	236
3.65	20	4.40	69	5.50	151		

The above table is applicable only for open-channel conditions. It is based up[illegible] 5 discharge measurements made during 1904, and is fairly well defined.

Estimated monthly discharge of Milk Creek near Axial, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 20–30	236	104	178	3,883
May	218	76	157	9,654
June	143	10	55	3,273
July	8	2	3.6	221
August	87	1	6.7	412
September	17	1	4.8	286
October	23	2	6.6	406
The period				18,140

LITTLE SNAKE RIVER NEAR MAYBELL, COLO.

This station was established April 18, 1904, by Oro McDermith. It is located on the wagon bridge on the road to Browns Park, about 30 miles west of Maybell, Colo., and about 90 miles from Meeker, Colo. The gage is a 2 by 4 inch by 12-foot timber, placed vertically against the rock cliff which extends into the river on the left side of the stream. It is read once each day by John M. Karr. Discharge measurements are made from the downstream side of the single-span bridge. The initial point for soundings is the vertical wall of the masonry abutment at the left end of the bridge. The channel is straight for about 200 feet above and for 150 feet below the station. The current is sluggish above and swift below the station, the river breaking into rapids about 100 feet below the bridge. Both banks are high and rocky and are not subject to overflow. The bed of the stream is composed of rock covered with quicksand. A United States Geological Survey standard aluminum bench-mark tablet is placed on the apex of the rocky ledge about 20 feet northeast of the left end of the bridge. Its elevation is 10.98 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Little Snake River near Maybell, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 18	O. McDermith	96	410	2.92	5.20	1,198
June 9	do	103	526	3.40	5.83	1,791
July 18	do	90	74	1.88	1.90	139
August 19	do	49	28	1.39	1.05	39

Mean daily gage height, in second-feet, of Little Snake River near Maybell, Colo., for 1904.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	.....	4.10	1.30	12	5.80	3.20	2.00	23	4.90	1.60	.....
2	.....	4.10	1.20	13	5.90	3.10	1.50	24	4.80	1.60	.....
3	.....	3.80	1.20	14	5.90	3.00	1.50	25	4.70	1.70	.....
4	.....	3.70	1.20	15	5.70	3.00	.....	26	4.60	2.00	.....
5	.....	3.60	1.20	16	5.70	a2.50	.....	27	4.50	1.60	.....
6	.....	3.60	1.20	17	5.50	a2.40	.....	28	4.40	1.60	.....
7	.....	3.50	1.20	18	5.50	1.90	.....	29	4.30	1.70	.....
8	.....	3.50	1.20	19	5.60	1.80	.....	30	4.20	1.70	.....
9	5.80	3.40	1.20	20	5.40	1.80	.....	31	.....	1.80	.....
10	6.40	3.30	1.10	21	5.40	1.70	.....				
11	6.10	3.30	1.10	22	5.10	1.70	.....				

a Estimated.

Rating table for Little Snake River near Maybell, Colo., from April 18 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	43	2.50	240	3.90	635	5.20	1,280
1.20	53	2.60	261	4.00	675	5.30	1,340
1.30	63	2.70	283	4.10	715	5.40	1,410
1.40	74	2.80	306	4.20	760	5.50	1,480
1.50	86	2.90	330	4.30	805	5.60	1,550
1.60	99	3.00	355	4.40	850	5.70	1,620
1.70	112	3.10	380	4.50	900	5.80	1,690
1.80	125	3.20	405	4.60	950	5.90	1,760
1.90	139	3.30	435	4.70	1,000	6.00	1,830
2.00	153	3.40	465	4.80	1,050	6.10	1,900
2.10	168	3.50	495	4.90	1,100	6.20	1,980
2.20	184	3.60	530	5.00	1,160	6.30	2,060
2.30	201	3.70	565	5.10	1,220	6.40	2,140
2.40	220	3.80	600				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of Little Snake River near Maybell, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 9–30	2,140	760	1,370	59,78[illegible]
July	715	63	306	18,8[illegible]
August 1–14	153	43	61.1	1,7[illegible]

ASHLEY CREEK NEAR VERNAL, UTAH.

This stream drains an area directly east of the Uinta basin. The station was established March 15, 1900, by C. T. Prall. The river emerges from its canyon about 7½ miles north of Vernal, Utah. The station is located near this point, at the highway bridge leading by the farm of the gage reader. The station is 1 mile below the mouth of Dry Fork and is above the series of canals by which Vernal Valley is irrigated. The gage is a vertical 1 by 5 inch board, 10 feet long, fastened to overhanging trees on the right bank just above the bridge. It is read twice each day by E. Marett. Discharge measurements are made at high water from the bridge and at ordinary stages by wading. The initial point for soundings is on the right bank. The channel is straight for 200 feet above and below the station. The current is swift. The right bank is high, not liable to overflow, and covered with trees. The left bank is low, covered with underbrush, and is subject to overflow at flood stages, at which time there are two or three channels. The bed of the stream is rough and rocky, and is not subject to change. The bench mark is a large nail, about which are driven three smaller nails, in a stump 50 feet west of the bridge. Its elevation is 7.21 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Ashley Creek near Vernal, Utah, 1903–1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 8	H. S. Reed	.....	316	5.33	4.50	1,685
August 24	do	.....	41	2.12	1.80	87
September 23	do	.....	41	1.80	1.75	74
November 9	do	.....	34	1.53	1.60	52
1904.						
January 24	H. S. Reed	35	37	1.08	1.60	40
March 30[b]	do	36	30	1.13	1.40	34
April 27	do	38	98	5.20	3.15	510
April 29	do	37	69	3.46	2.50	239
April 29	do	37	73	3.20	2.50	234
May 24	do	42	128	5.67	3.65	726
May 24	do	42	128	5.43	3.65	695
August 6[b]	do	36	35	1.91	1.85	67
August 6[b]	do	36	35	1.60	1.85	56
December 23	do	34	23	1.26	1.40	29

[a] All gage heights refer to new rod established June 8, 1903. [b] Measurement by wading.

NOTE.—Discharge measurements for 1903 prior to June 8 are published in 1903 report.

Mean daily gage height, in feet, of Ashley River near Vernal, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	1.40	1.30	1.40	2.60	2.90	2.10	1.90	1.80	1.80	1.80	1.7
2	1.40	1.40	1.30	1.40	2.40	2.95	2.00	1.90	1.80	1.70	1.80	1.7
3	1.40	1.40	1.30	1.40	2.30	3.00	2.00	1.90	1.80	1.70	1.80	1.7
4	1.40	1.40	1.30	1.40	2.35	2.95	2.00	1.85	1.80	1.70	1.80	1.7
5	1.40	1.40	1.30	1.40	2.50	2.90	2.00	1.80	1.80	1.70	1.80	1.7
6	1.40	1.40	1.30	1.40	2.65	3.00	2.00	1.80	1.80	1.70	1.70	1.7
7	1.40	1.40	1.30	1.45	2.55	3.10	2.10	1.80	1.80	1.85	1.70	1.7
8	1.40	1.40	1.30	1.50	2.40	3.30	2.10	1.80	1.80	1.80	1.70	1.7
9	1.40	1.40	1.30	1.55	2.60	3.10	2.10	1.80	1.80	1.80	1.70	1.7
10	1.40	1.80	1.30	2.25	2.75	3.05	2.10	1.80	1.80	1.80	1.70	1.7
11	1.40	1.55	1.30	2.25	3.00	2.95	2.10	1.80	1.80	1.80	1.70	1.7
12	1.40	1.40	1.30	1.90	2.95	2.85	2.10	1.80	1.80	1.80	1.70	1.7
13	1.40	1.40	1.30	1.95	3.35	2.80	2.10	1.80	1.80	1.80	1.60	1.7
14	1.40	1.40	1.30	2.45	3.55	2.80	2.00	1.95	1.80	1.80	1.60	1.7
15	1.40	1.40	1.30	2.75	3.45	2.70	2.00	2.00	1.80	1.80	1.60	1.7
16	1.40	1.40	1.30	2.15	3.55	2.70	2.00	2.00	1.80	1.80	1.60	1.7
17	1.40	1.40	1.30	2.40	3.45	2.65	2.00	2.00	1.80	1.80	1.60	1.7
18	1.40	1.40	1.30	3.20	3.90	2.60	2.00	2.00	1.80	1.80	1.60	1.7
19	1.40	1.40	1.30	2.80	3.75	2.50	2.00	2.05	1.80	1.80	1.60	1.7
20	1.40	1.40	1.45	2.50	3.40	2.50	2.00	2.00	1.80	1.80	1.60	1.7
21	1.40	1.30	1.30	2.35	3.45	2.40	2.00	1.90	1.80	1.80	1.60	1.7
22	1.40	1.30	1.30	2.00	3.45	2.40	2.00	1.90	2.40	1.80	1.60	1.7
23	1.40	1.30	1.30	1.90	4.00	2.40	2.00	1.90	2.00	1.80	1.60	1.7
24	1.40	1.30	1.30	2.10	3.70	2.30	2.05	1.90	2.00	1.80	1.60	1.7
25	1.40	1.30	1.35	2.85	3.65	2.30	1.95	1.90	1.90	1.80	1.60	1.7
26	1.40	1.30	1.30	3.15	3.45	2.30	1.90	1.90	1.90	1.80	1.60	1.7
27	1.40	1.30	1.30	3.20	3.60	2.20	1.90	1.90	1.80	1.80	1.60	1.7
28	1.40	1.30	1.30	2.90	3.25	2.20	1.90	1.90	1.80	1.80	1.60	1.7
29	1.40	1.30	1.55	2.40	3.20	2.15	1.90	1.90	1.80	1.80	1.60	1.7
30	1.40	.....	1.40	2.30	3.10	2.10	1.90	1.90	1.80	1.80	1.50	1.7
31	1.40	.....	1.40	.....	3.00	.....	1.90	1.90	.....	1.80	.....	1.7

Rating table for Ashley Creek near Vernal, Utah, from June 9, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	25	2.20	150	3.00	433	3.80	815
1.40	31	2.30	176	3.10	478	3.90	890
1.50	38	2.40	205	3.20	523	4.00	985
1.60	47	2.50	236	3.30	568	4.10	1,100
1.70	58	2.60	270	3.40	613	4.20	1,235
1.80	71	2.70	307	3.50	658	4.30	1,380
1.90	87	2.80	347	3.60	705	4.40	1,530
2.00	105	2.90	389	3.70	755	4.50	1,685
2.10	126						

The above table is applicable only for open-channel conditions. It is based up 12 discharge measurements made between the limits of the table. It is well defi between gage heights 1.30 feet and 3.70 feet. Above gage height 3.70 feet the curv determined by one measurement.

Estimated monthly discharge of Ashley Creek near Vernal, Utah, for 1903 and 1904.

[Drainage area, 250 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
June	2,065	236	893	53,140	3.57	3.98
July	270	105	172	10,580	.688	.793
August	105	58	76.4	4,698	.306	.353
September	105	47	60.2	3,582	.241	.269
October	96	47	63.2	3,886	.253	.292
November	58	38	45.3	2,696	.181	.202
December	31	31	31.0	1,906	.124	.143
1904.						
January	31	31	31.0	1,906	0.124	0.143
February	71	25	30.9	1,777	.124	.134
March	42	25	26.3	1,617	.105	.121
April	523	31	182	10,830	.728	.812
May	985	176	511	31,420	2.04	2.35
June	568	126	309	18,390	1.24	1.38
July	126	87	107	6,579	.428	.493
August	116	71	86.2	5,300	.345	.398
September	205	71	78.8	4,689	.315	.351
October	79	58	69.2	4,255	.277	.319
November	71	38	53.3	3,172	.213	.238
December	47	31	36.5	2,244	.146	.168
The year	985	25	127	92,180	.507	6.91

ASHLEY CREEK (DRY FORK) NEAR VERNAL, UTAH.

The many branches of Ashley Creek drain an area of approximately 250 square miles in northeastern Utah. This area is situated entirely within the Uinta Forest Reserve, in Uinta County, between the drainage areas of Brush Creek, Green River, and Uinta River. The streams receive their water from a series of small lakes on the summit and the southern slopes of the Uinta Mountains, thus insuring a never-failing supply. They finally join at the base of the mountains, and enter Ashley Valley 8 miles above the town of Vernal in one stream. The peculiar feature of the streams between the Uinta River and Green River is that at some point in their course they disappear, except during the spring floods, and that, with the exception of Dry Fork, which

is the most westerly branch of Ashley Creek, reappear later in the year.

Dry Fork has its source in a lake in the Uinta Mountains, about 35 miles northwest of Vernal, Utah. Its length is about 28 miles, and for 23 miles it flows in a canyon varying from 500 feet to one-half mile in width. Its general direction is southeast, and it has a fall of at least 150 feet per mile. It enters Ashley Creek about 8 miles above the town of Vernal. About midway the stream's length, or 10 miles northwest of Dry Fork post-office, a gaging was made on August 20, 1901, which gave a discharge of 96 second-feet. About 1,200 feet below this point occurs a pool, or sink, lying in a circular basin whose banks, except on the upstream side, are from 75 to 100 feet high. The stream enters this pool through several inlets. The pool is apparently bottomless. The water in its larger end has a slow circular motion, but whether this is caused by the incoming stream or by suction from below could not be determined. The only visible outlet is a narrow, rocky channel which has been widened by blasting in an effort to increase its flow. When visited in 1901 this was carrying about 10 second-feet, all of which disappeared within a mile below.

Only three times since 1879 has the water reappeared in the channel of Dry Fork after the spring floods have subsided. One of these was during the last year.

The first flow of 1904 commenced on the night of May 12, when, approximately, the stream was carrying 100 second-feet. It reached its maximum height May 22, which it held until May 24, when a measurement was made just above its mouth. It was then carrying 308 second-feet, or practically 42 per cent of the discharge of Ashley Creek at the station about 1 mile below the junction of Dry Fork with the main stream. The flow gradually decreased from day to day until July 15, 1904, when it completely subsided. Previous to and at the time of the maximum discharge of this branch, it, in all probability, was carrying more than 42 per cent of the entire discharge at the station, for the season of high water during average years does not occur on this branch until after the greater portion of Ashley Creek's high water has passed. As an approximation of what this stream was carrying, the following tables, which are thought to be a fair estimate of its discharge, have been prepared.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Mean daily discharge, in second-feet, of Ashley Creek (Dry Fork) near Vernal, Utah, for 1904.

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1	.....	260	80	12	100	194	14	23	350	128	.....
2	.....	254	74	13	117	188	10	24	308	122	.....
3	.....	248	68	14	134	182	6	25	302	116	.....
4	.....	242	62	15	151	176	0	26	296	110	.....
5	.....	236	56	16	168	170	.....	27	290	104	.....
6	.....	230	50	17	185	164	.....	28	284	98	.....
7	.....	224	44	18	202	158	.....	29	278	92	.....
8	.....	218	38	19	219	152	.....	30	272	86	.....
9	.....	212	32	20	260	146	.....	31	266	.....	.....
10	.....	206	26	21	300	140	.....				
11	.....	200	20	22	350	134	.....				

Estimated monthly discharge of Ashley Creek (Dry Fork) near Vernal, Utah, for 1904.

Month.	Dicharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 12–31	350	100	242	9,584
June	260	86	173	10,290
July 1–15	80	0	38	1,150

WHITE RIVER (NORTH FORK) NEAR BUFORD, COLO.

This station was established July 28, 1903, by Robert S. Stockton. It is located at the county bridge at Rawson's ranch, below the mouth of Marvine Creek, 7 miles from Buford, the nearest post-office, and 32 miles from Meeker, Colo. The gage is a 2 by 4 inch vertical pine timber, spiked to the lower side of the first pier from the south end of the bridge. It reads from 1 to 9 feet. It is read twice each day by H. N. Rawson. Discharge measurements are made from the three-span highway bridge to which the gage is attached. It has a total span of 85 feet. The initial point for soundings is the edge of the abutment at the south end of the bridge. The channel is straight for 200 feet above and 300 feet below the station, and the current is swift. Both banks are high and are not liable to overflow. The right bank is covered with trees and brush. The bed of the stream is rocky and free from vegetation. There is but one channel at all stages, broken by the two narrow bridge piers. Bench mark No. 1 is the top of a bolt on the bridge nearest the gage. Its elevation is 11.51 feet above the zero of the gage. Bench mark No. 2 is a spike in the trunk of a large cottonwood tree at the southeast corner of the bridge. Its elevation is 7.46 feet above the zero of the gage. Bench mark No. 3 is

a spike in one of the abutment logs at the end of the upper sill at the southwest corner of the bridge. Its elevation is 7.88 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of White River (North Fork) near Buford, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	O. McDermith	87	118	3.92	2.40	462
June 4	do	87	162	4.70	3.00	762
July 7	do	87	118	3.82	2.40	451
August 3	do	82	90	3.27	2.08	294
September 10	do	82	77	3.04	2.00	234

Mean daily gage height, in feet, of White River (North Fork) near Buford, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.00	2.98	3.30	2.60	2.08	2.10	2.00
2	1.95	2.80	3.20	2.55	2.08	2.05	2.00
3	1.85	2.62	3.15	2.50	2.05	2.05	1.98
4	1.92	2.45	3.05	2.50	2.05	2.00	1.95
5	1.95	2.55	3.05	2.40	2.05	2.00	1.95
6	1.90	2.65	2.92	2.40	2.05	2.00	1.98
7	1.90	2.80	2.92	2.40	2.05	2.00	2.02
8	1.95	2.65	2.95	2.40	2.05	2.00	2.00
9	1.90	2.68	3.05	2.35	2.05	2.00	2.05
10	1.88	2.92	3.25	2.30	2.05	2.00	2.00
11	1.95	3.05	3.30	2.28	2.05	2.00	2.00
12	2.05	3.25	3.30	2.25	2.05	2.00	2.00
13	2.12	3.40	3.40	2.28	2.05	2.00	2.00
14	2.20	3.25	3.55	2.25	2.05	1.98	2.00
15	2.28	3.20	3.40	2.22	2.05	1.95	2.00
16	2.38	3.30	3.35	2.22	2.05	1.95	1.95
17	2.42	3.35	3.15	2.20	2.05	1.98	1.95
18	2.70	3.45	3.10	2.18	2.10	2.00	1.95
19	2.68	3.42	3.12	2.18	2.05	1.95	1.95
20	2.80	3.25	3.05	2.15	2.05	1.95	1.92
21	2.65	3.20	3.05	2.15	2.05	1.95	1.92
22	2.30	3.30	2.98	2.15	2.05	2.00	1.92
23	2.05	3.45	2.90	2.15	2.00	1.98	1.92
24	2.15	3.45	2.82	2.15	2.00	1.98	1.92
25	2.40	3.40	2.75	2.15	2.00	2.00	1.92
26	2.58	3.42	2.72	2.15	2.00	2.00	1.92
27	2.68	3.35	2.70	2.15	2.00	1.98	1.92
28	3.15	3.30	2.68	2.15	2.12	1.98	1.92
29	2.95	3.35	2.65	2.20	2.02	2.00	1.92
30	3.00	3.30	2.65	2.12	2.00	2.00	1.92
31		3.30		2.12	2.02		1.92

Rating table for White River (North Fork) near Buford, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.85	175	2.15	325	2.45	475	3.00	760
1.90	200	2.20	350	2.50	500	3.10	820
1.95	225	2.25	375	2.60	550	3.20	880
2.00	250	2.30	400	2.70	600	3.30	940
2.05	275	2.35	425	2.80	650	3.40	1,000
2.10	300	2.40	450	2.90	700	3.50	1,060

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.00 feet and 3.00 feet. The table has been extended beyond these limits. Above gage height 3.00 feet the rating curve is a tangent, the difference being 60 per tenth.

Estimated monthly discharge of White River (North Fork) near Buford, Colo., for 1904.

[Drainage area, 181 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	850	175	396	23,560	2.19	2.43
May	1,030	475	841	51,710	4.65	5.36
June	1,090	575	794	47,250	4.39	4.90
July	550	310	383	23,550	2.12	2.44
August	310	250	272	16,720	1.50	1.73
September	300	225	247	14,700	1.36	1.52
October	275	210	230	14,140	1.27	1.47
The period	.....	.....	.....	191,600	.....	.....

WHITE RIVER (SOUTH FORK) NEAR BUFORD, COLO.

This station was established July 25, 1903, by Robert S. Stockton. It is located at the county bridge at the lower end of a section of the river known as the "Stillwater." It is about 7 miles from Buford, Colo., the nearest post-office, and is about 30 miles from Meeker, Colo. The elevation above sea level as determined by aneroid barometer is 7,400 feet. The gage is a 2 by 4 inch vertical pine timber 10 feet long. It is spiked to the upper side of the middle pier. It is read twice each day by George Hazard. Discharge measurements are made from the bridge at high water and by wading at low water. The initial point for soundings is the edge of the abutment at the west end of the bridge. The bridge makes an angle of 22° with the normal to the stream. This is taken into account in making measurements. The channel is straight for 50 feet above the station and for 300 feet below. The current is swift. Both banks are high, covered with grass and sagebrush, and are not subject to overflow. The bed of the stream below the Stillwater and at the gaging station is covered with bowlders, some of which are 2 or 3 feet in diameter. There is but one channel, broken by the middle pier of the bridge. Bench mark No. 1 is the first bolt on the bridge east of the gage. Its elevation is 11.95 feet above the zero of the gage. Bench mark No. 2 is a spike in one of the logs of the abutment at the southwest corner of the bridge. Its elevation is 8.57 feet above the zero of the gage. Bench mark No. 3 is the corner of a large rock 30 feet west of the bridge and north of the road. Its elevation is 13.14 feet above the zero of the gage. Bench mark No. 4 is the top of a pyramid-shaped rock on the east side of the river below the bridge, 41 feet distant from the northeast bolt on the bridge tie. The rock projects 8 inches above the ground. The elevation of the bench mark is 7.02 feet above the zero of the gage. The bridge has a span between abutments of 55 feet.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of White River (South Fork) near Buford, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 25	McDermith and Lamb	49	80	3.39	2.80	271
June 2	O. McDermith	56	187	6.00	4.85	1,122
July 6	do	54	101	3.72	3.18	376
August 2	do	46	62	3.64	2.70	226
September 13	do	43	58	2.52	2.51	146

Mean daily gage height, in feet, of White River (South Fork) near Buford, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.42	3.20	5.20	3.35	2.68	2.70	2.55
2	2.42	3.22	5.15	3.32	2.65	2.68	2.55
3	2.42	3.15	4.70	3.25	2.65	2.62	2.50
4	2.42	3.08	4.22	3.22	2.65	2.60	2.50
5	2.42	3.02	3.90	3.18	2.65	2.55	2.50
6	2.42	3.00	3.88	3.12	2.65	2.55	2.50
7	2.42	3.15	4.22	3.10	2.65	2.55	2.62
8	2.42	3.12	4.50	3.10	2.60	2.50	2.58
9	2.42	3.10	4.40	3.02	2.60	2.50	2.58
10	2.45	3.18	4.70	3.00	2.60	2.50	2.60
11	2.50	3.30	5.45	3.00	2.60	2.50	2.58
12	2.62	3.58	5.10	2.95	2.60	2.50	2.60
13	2.72	3.70	5.40	2.95	2.60	2.50	2.58
14	2.80	3.85	5.35	2.95	2.60	2.50	2.55
15	2.82	3.88	4.65	2.90	2.60	2.50	2.52
16	2.85	3.72	4.45	2.88	2.60	2.50	2.50
17	2.90	3.72	4.35	2.82	2.60	2.50	2.50
18	2.95	3.98	4.30	2.80	2.65	2.55	2.50
19	3.00	4.40	4.35	2.80	2.65	2.52	2.48
20	3.00	4.45	4.28	2.80	2.62	2.50	2.45
21	3.02	4.55	4.05	2.78	2.60	2.50	2.48
22	2.95	4.78	3.90	2.75	2.55	2.55	2.45
23	2.90	5.55	3.78	2.75	2.55	2.68	2.50
24	2.82	6.25	3.78	2.80	2.55	2.58	2.50
25	2.80	6.00	3.65	2.75	2.55	2.52	2.48
26	2.88	5.35	3.60	2.75	2.55	2.60	2.48
27	2.95	5.35	3.55	2.70	2.58	2.58	2.48
28	3.10	5.30	3.50	2.75	2.70	2.55	2.48
29	3.18	5.30	3.45	2.75	2.65	2.55	2.48
30	3.18	5.50	3.42	2.72	2.65	2.58	2.48
31	.....	5.60	.....	2.70	2.60	.....	2.50

Rating table for White River (South Fork) near Buford, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
2.40	154	3.10	362	3.80	640	5.00	1,200
2.45	165	3.15	380	3.85	660	5.10	1,250
2.50	177	3.20	400	3.90	680	5.20	1,300
2.55	190	3.25	420	3.95	700	5.30	1,350
2.60	204	3.30	440	4.00	720	5.40	1,400
2.65	219	3.35	460	4.10	760	5.50	1,450
2.70	234	3.40	480	4.20	800	5.60	1,500
2.75	249	3.45	500	4.30	850	5.70	1,550
2.80	264	3.50	520	4.40	900	5.80	1,600
2.85	280	3.55	540	4.50	950	5.90	1,650
2.90	296	3.60	560	4.60	1,000	6.00	1,700
2.95	312	3.65	580	4.70	1,050	6.10	1,750
3.00	328	3.70	600	4.80	1,100	6.20	1,800
3.05	345	3.75	620	4.90	1,150		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1903 and 1904. It is not well defined and has been extended above gage height 4.85 feet. Above gage height 4.20 feet the rating curve is a tangent, the difference being 50 per tenth.

Estimated monthly discharge of White River (South Fork) near Buford, Colo., for 1904.

[Drainage area, 148 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	392	158	251	14,940	1.70	1.89
May	1,825	328	834	51,280	5.64	6.50
June	1,425	488	872	51,890	5.89	6.57
July	460	234	307	18,880	2.07	2.39
August	234	190	208	12,790	1.40	1.62
September	234	177	191	11,370	1.29	1.44
October	210	165	182	11,190	1.23	1.42
The period				172,300		

WHITE RIVER NEAR MEEKER, COLO.

This station was established by A. L. Fellows, May 24, 1901, about one-half mile above the town of Meeker, at a point where a wagon bridge crosses the stream on the ranch of L. F. Van Cleave. The gage rod consists of a vertical 2 by 4 inch timber nailed to the left abutment of the bridge on the downstream side. The bridge is marked every 5 feet. The initial point for soundings is at the rod at the left or south end of the bridge. The channel is straight for 500 feet above and below the station. The current is swift. There is but one channel at all stages. The banks are so high that they are not liable to overflow; the channel is of rock and gravel and seems permanent in its nature. Measurements are made from the lower side of the wagon bridge. The observer is L. F. Van Cleave, who reads the rod twice each day. Bench mark No. 1 is top of bolt in truss immediately above gage rod; elevation above zero of gage, 10.83 feet. Bench mark No. 2 is spike driven in left post of gate near bottom; elevation above zero of gage, 9.29 feet. Bench mark No. 3 is a nail on south side of post directly east of bench mark No. 2; elevation above zero of gage, 9.14 feet. Bench mark No. 4 is a United States Geological Survey standard iron bench mark located 30 feet north of the north end of the bridge. Its elevation is 8.807 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of White River near Meeker, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 12	O. McDermith	79	207	2.74	4.00	568
April 23	do	79	258	3.37	4.60	871
April 27	W. A. Lamb	79	275	3.65	4.75	1,003
May 23	O. McDermith	79	367	6.21	5.79	2,280
May 31	do	79	362	6.41	5.80	2,322
June 13	do	79	358	6.37	5.77	2,282
July 5	do	79	228	3.18	4.33	724
August 1	do	79	188	2.09	3.70	392
August 15	do	79	191	2.13	3.71	406
September 8	do	79	184	2.24	3.75	412

Mean daily gage height, in feet, of White River near Meeker, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.70	5.20	5.65	4.52	3.70	3.98	3.78
2	3.70	5.12	5.65	4.48	3.70	3.95	3.75
3	3.65	4.95	5.60	4.42	3.68	3.85	3.72
4	3.65	4.82	5.35	4.38	3.68	3.80	3.68
5	3.62	4.75	5.15	4.32	3.68	3.75	3.65
6	3.62	4.82	5.10	4.30	3.68	3.75	3.65
7	3.60	5.02	5.18	4.30	3.65	3.72	3.70
8	3.55	4.85	5.40	4.32	3.65	3.70	3.70
9	3.60	4.80	5.40	4.20	3.68	3.70	3.82
10	3.62	5.00	5.40	4.20	3.65	3.70	3.85
11	3.82	5.20	5.70	4.15	3.68	3.70	3.82
12	3.95	5.45	5.60	4.10	3.72	3.65	3.80
13	4.08	5.50	5.72	4.10	3.70	3.65	3.78
14	4.25	5.55	5.58	4.08	3.68	3.65	3.75
15	4.45	5.62	5.55	4.00	3.70	3.65	3.75
16	4.50	5.42	5.42	3.98	3.70	3.70	3.75
17	4.55	5.42	5.38	3.90	3.70	3.68	3.75
18	4.65	5.45	5.32	3.88	3.90	3.75	3.70
19	4.90	5.65	5.32	3.85	3.85	3.75	3.68
20	4.80	5.65	5.30	3.78	3.85	3.70	3.68
21	5.05	5.55	5.18	3.80	3.78	3.65	3.68
22	4.70	5.55	5.15	3.78	3.70	3.68	3.70
23	4.55	5.78	5.02	3.75	3.70	3.65	3.70
24	4.52	5.90	5.02	3.80	3.70	3.68	3.70
25	4.38	5.92	4.95	3.80	3.70	3.70	3.70
26	4.55	5.75	4.82	3.75	3.70	3.80	3.70
27	4.78	5.70	4.75	3.72	3.78	3.75	3.68
28	5.12	5.70	4.65	3.70	3.95	3.72	3.68
29	5.28	5.70	4.62	3.80	3.88	3.72	3.68
30	5.10	5.72	4.58	3.78	3.85	3.75	3.68
31	.....	5.75	.....	3.72	3.90	.....	3.68

Rating table for White River near Meeker, Colo., from April 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.55	335	3.95	515	4.60	890	5.30	1,590
3.60	355	4.00	540	4.70	960	5.40	1,730
3.65	375	4.10	590	4.80	1,040	5.50	1,870
3.70	395	4.20	650	4.90	1,130	5.60	2,010
3.75	415	4.30	710	5.00	1,230	5.70	2,160
3.80	440	4.40	770	5.10	1,350	5.80	2,320
3.85	465	4.50	830	5.20	1,470	5.90	2,480
3.90	490						

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1904. It is well defined between gage heights 3.70 feet and 4.75 feet. The upper part of the curve is determined by 4 measurements near gage height 5.75 feet.

Estimated monthly discharge of White River near Meeker, Colo., for 1904.

[Drainage area, 634 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,566	335	745	44,330	1.18	1.32
May	2,512	1,000	1,763	108,400	2.78	3.20
June	2,192	878	1,570	93,420	2.48	2.77
July	842	395	559	34,370	.882	1.02
August	515	375	413	25,390	.651	.750
September	530	375	409	24,340	.645	.720
October	465	375	404	24,840	.637	.734
The period				355,100		

WHITE RIVER NEAR RANGELY, COLO.

This station was established April 14, 1904, by Oro McDermith. It is located at the wagon bridge 1 mile west of Rangely, Colo. The gage is a 2 by 4 inch timber 12 feet long, graduated to feet and tenths, fastened to the masonry abutment at the right bank. It is read twice each day by John Gothard. Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The initial point for soundings is the vertical wall of the right abutment. Distances from the initial point are marked with white paint on the hand rail of the bridge. The channel is straight for about 150 feet above and for 200 feet below the station. The current is swift, but at low stages becomes rather sluggish above the bridge. The right bank is high and clean and does not overflow. The left bank is low and clean and is subject to overflow. On this bank the roadway approaches the bridge on an embankment. The bed of the stream is composed of sand and is shifting. There is but one channel at all stages. The bridge is not quite at right angles to the course of the stream. A United States Geological Survey standard aluminum bench-mark tablet is set on the top stone of the right abutment on the downstream side. Its elevation is 16.857 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of White River near Rangely, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 14	O. McDermith	78	223	2.98	3.95	665
May 28	do	87	398	5.38	5.65	2,120
July 12	do	75	248	2.46	3.90	609
August 9	do	72	195	1.53	3.45	298
September 18	do	72	155	2.69	3.58	417

Mean daily gage height, in feet, of White River near Rangely, Colo., for 1904.

Day.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.
1	.....	4.65	5.50	4.20	3.40	4.10	3.50	3.50
2	.....	4.65	5.45	4.20	3.40	3.95	3.50	3.50
3	.....	4.60	5.45	4.20	3.40	3.85	3.50	.....
4	.....	4.55	5.45	4.20	3.40	3.75	3.50	.....
5	.....	4.45	5.25	4.15	3.40	3.70	3.50	.....
6	.....	4.35	5.10	4.00	3.40	3.60	3.60	.....
7	.....	4.35	5.00	4.00	3.40	3.60	3.60	.....
8	.....	4.50	5.55	4.00	3.40	3.60	3.60	.....
9	.....	4.40	5.60	4.00	3.40	3.50	3.65	.....
10	.....	4.35	5.40	4.00	3.40	3.50	3.65	.....
11	.....	4.45	5.25	4.00	3.76	3.50	3.70	.....
12	.....	4.80	5.40	3.95	3.55	3.50	3.70	.....
13	.....	4.95	5.35	3.90	3.50	3.50	3.60	.....
14	.....	5.00	5.45	3.90	3.50	3.50	3.60	.....
15	4.00	5.20	5.50	3.90	3.50	3.50	3.60	.....
16	4.00	5.20	5.40	3.80	3.50	3.50	3.60	.....
17	4.02	5.20	5.35	3.80	4.15	3.50	3.60	.....
18	4.04	5.05	5.15	3.70	3.90	3.55	3.60	.....
19	4.04	5.10	4.95	3.70	3.90	3.60	3.60	.....
20	4.06	5.25	4.95	3.60	3.85	3.60	3.60	.....
21	4.04	5.30	4.95	3.60	3.75	3.60	3.60	.....
22	4.05	5.20	4.80	3.60	3.70	3.50	3.60	.....
23	4.04	5.25	4.75	3.50	3.70	3.50	3.60	.....
24	4.19	5.40	4.60	3.50	3.70	3.50	3.60	.....
25	4.04	5.65	4.60	3.50	3.70	3.50	3.60	.....
26	4.18	5.90	4.55	3.50	3.65	3.50	3.60	.....
27	4.02	5.60	4.55	3.40	3.60	3.50	3.60	.....
28	4.03	5.45	4.45	3.30	3.60	3.50	3.50	.....
29	4.06	5.45	4.30	3.30	3.75	3.50	3.50	.....
30	4.53	5.45	4.25	3.95	4.05	3.50	3.50	.....
31	.....	5.65	.....	3.40	3.80	.....	3.50	.....

Rating table for White River near Rangely, Colo., from April 14 to December 31, 1904:

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	225	3.75	515	4.40	990	5.20	1,685
3.35	255	3.80	550	4.50	1,070	5.30	1,775
3.40	285	3.85	585	4.60	1,150	5.40	1,870
3.45	315	3.90	620	4.70	1,235	5.50	1,970
3.50	345	3.95	655	4.80	1,325	5.60	2,070
3.55	375	4.00	690	4.90	1,415	5.70	2,170
3.60	410	4.10	760	5.00	1,505	5.80	2,270
3.65	445	4.20	830	5.10	1,595	5.90	2,370
3.70	480	4.30	910				

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined.

Estimated monthly discharge of White River near Rangely, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 15–30	1,110	690	753	23,900
May	2,370	950	1,527	93,890
June	2,070	870	1,582	94,130
July	830	225	552	33,940
August	795	285	427	26,260
September	760	345	401	23,860
October	480	345	399	24,530
The period				321,500

WHITE RIVER NEAR OURAY, UTAH.

This station was established March 22, 1904, by H. S. Reed. It is located at the site of the White River Dam and Canal Company's dam, 14 miles from Ouray, Utah. The nearest town is Vernal, Utah, 30 miles distant, and the nearest railroad station is Price, Utah, 130 miles distant. The station is below all tributaries. A vertical staff gage is attached to the upstream face of the crib work of the dam near the right bank. It is read twice each day by T. T. Holdaway. Discharge measurements are made by wading and by means of a boat at a point about 600 feet below the dam, by stretching a tagged rope across the stream and there is a good current. The channel is straight for about 600 feet above and 1,500 feet below the station. Both banks are high and do not overflow. The bed of the stream is composed of clean sand and is shifting. The bench mark is a T cut in the solid rock about 100 feet northeast of the gage rod on the right bank. Its elevation is 13.185 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of White River near Ouray, Utah, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 22	H. S. Reed	104	224	1.80	2.00	403
June 4	do	103	578	3.53	5.90	2,040
August 15	do	107	186	1.76	2.10	328
October 28	do	108	192	1.79	2.20	344

Mean daily gage height, in feet, of White River near Ouray, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1	.....	2.20	4.40	6.15	17	.....	2.75	5.30	5.50
2	.....	2.05	4.25	5.85	18	.....	3.00	5.00	5.45
3	.....	2.05	4.40	5.70	19	.....	3.10	4.82	5.00
4	.....	2.10	4.60	5.82	20	.....	3.30	5.05	4.85
5	.....	1.95	3.85	5.70	21	.....	3.55	5.50	4.80
6	.....	1.92	3.75	5.05	22	2.00	3.90	5.60	.....
7	.....	1.98	3.60	4.65	23	.....	3.78	5.20	.....
8	.....	1.88	3.70	4.50	24	.....	3.48	5.55	.....
9	.....	1.85	4.05	6.70	25	.....	3.25	5.80	.....
10	.....	1.80	3.80	5.25	26	.....	3.20	7.10	.....
11	.....	1.78	3.65	5.05	27	.....	2.98	6.70	.....
12	.....	1.75	3.95	5.25	28	.....	3.05	6.15	.....
13	.....	1.85	4.40	5.20	29	.....	3.45	5.70	.....
14	.....	2.00	4.75	5.50	30	.....	4.05	5.75	.....
15	.....	2.25	4.95	5.70	31	.....	.....	5.70	.....
16	.....	2.50	5.08	5.90					

MARVINE CREEK NEAR BUFORD, COLO.

This station is located at a point where the stream is crossed by a large aspen log. The nearest post-office is Buford, Colo., about 10 miles distant. Meeker, Colo., is about 35 miles distant. The elevation of this point, as determined by an aneroid barometer, is 7,550 feet above sea level. The gage is a vertical 2 by 4 inch pine timber 5 feet long, fastened to the lower side of the foot log, which is used as a bridge. Discharge measurements are made from the log which spans the stream at the gage. The channel is 30 feet wide at this point. The initial point for soundings is at the gage rod. The channel is straight for 100 feet above and below the station, and the current is swift. The right bank is sloping and will overflow for 10 or 15 feet at high water. The left bank is steep and will not overflow. Both banks are covered with thick brush. The bed of the stream at the station is covered with bowlders and is free from vegetation. The channel is divided into two parts by a large sunken log, which supports the middle of the foot bridge. Bench mark No. 1 is the top of a rock 22 feet west of the gage rod. Its elevation is 4.62 feet above the zero of the gage. Bench mark No. 2 is the top of a triangular-shaped rock between two spruce trees on the west bank. Its elevation is 6.01 feet above the zero of the gage. Bench mark No. 3 is the top of a large rock 30 feet northwest of the gage. Its elevation is 4.61 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Marvine Creek near Buford, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	McDermith and Lamb	29	36	2.75	2.00	99
June 4	O. McDermith	30	46	5.30	2.50	244
July 7	do	30	44	3.55	2.15	156
August 3	do	26	35	4.29	2.07	150
September 10	do	28	32	3.34	1.90	107

Mean daily gage height, in feet, of Marvine Creek near Buford, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.15	2.50	2.20	1.95	2.05	1.[illegible]
2	.....	2.18	2.45	2.20	1.95	2.00	1.[illegible]
3	.....	2.10	2.50	2.20	1.85	1.90	1.[illegible]
4	.....	2.20	2.50	2.20	2.00	1.90	1.[illegible]
5	.....	2.15	2.45	2.25	2.00	1.90	1.[illegible]
6	.....	2.15	2.45	2.20	2.00	1.90	1.[illegible]
7	.....	2.15	2.45	2.15	2.00	1.90	1.[illegible]
8	.....	2.15	2.50	2.15	2.00	1.90	1.[illegible]
9	.....	2.20	2.50	2.15	2.00	1.90	1.[illegible]
10	.....	2.25	2.50	2.10	2.00	1.90	1.[illegible]
11	.....	2.28	2.55	2.10	2.00	1.90	1.[illegible]
12	.....	2.35	2.70	2.10	2.00	1.90	1.[illegible]
13	.....	2.35	2.80	2.05	1.90	1.90	1.[illegible]
14	.....	2.35	2.60	2.00	1.90	1.88	.....
15	.....	2.30	2.50	2.00	1.90	1.88	.....
16	.....	2.32	2.45	2.00	1.90	1.90	.....
17	.....	2.35	2.45	2.00	1.90	1.85	.....
18	.....	2.40	2.40	2.00	2.00	1.85	.....
19	.....	2.45	2.35	2.00	1.95	1.85	.....
20	.....	2.42	2.40	2.00	1.95	1.85	.....
21	.....	2.48	2.35	2.00	2.00	1.85	.....
22	.....	2.45	2.35	1.97	1.90	1.85	.....
23	.....	2.45	2.35	1.97	1.90	1.90	.....
24	.....	2.45	2.30	1.97	1.90	1.88	.....
25	.....	2.50	2.15	1.97	1.90	1.85	.....
26	2.10	2.45	2.15	1.93	1.90	1.90	.....
27	2.20	2.55	2.10	1.93	1.90	1.85	.....
28	2.20	2.55	2.20	1.95	2.00	1.85	.....
29	2.18	2.50	2.25	1.95	2.00	1.85	.....
30	2.15	2.55	2.20	1.95	2.00	1.90	.....
31	.....	2.55	.....	1.95	2.05	.....	.....

Rating table for Marvine Creek near Buford, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.75	64	2.05	136	2.35	208	2.65	280
1.80	76	2.10	148	2.40	220	2.70	292
1.85	88	2.15	160	2.45	232	2.75	304
1.90	100	2.20	172	2.50	244	2.80	316
1.95	112	2.25	184	2.55	256	2.85	328
2.00	124	2.30	196	2.60	268	2.90	340

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1903 and 1904. It is not well defined. The rating curve is a tangent, the difference being 24 per tenth.

Estimated monthly discharge of Marvine Creek near Buford, Colo., for 1904.

[Drainage area, 50 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 26–30	172	148	164	1,630	3.28	0.608
May	256	148	207	12,730	4.14	4.77
June	316	148	223	13,270	4.46	4.98
July	184	107	136	8,362	2.72	3.14
August	136	88	113	6,948	2.26	2.60
September	136	88	97.5	5,802	1.95	2.18
October 1–13	100	88	90.9	2,344	1.82	.886
The period				51,090		

UINTA RIVER NEAR WHITEROCKS, UTAH.[a]

This station was established September 16, 1899, by C. C. Babb. It is located at the point where the river emerges from its canyon, about 10 miles northwest of the Indian agency at Whiterocks, Utah. The station is on the road to the Government sawmill, and is three-fourths of a mile above the bridge. It is 600 feet below the mouth of Pole Creek. The gage is an inclined 2 by 4 inch timber, 12 feet long, bolted to two trees on the left bank. Discharge measurements are made at flood stages by means of a cable and car. At ordinary stages they are made by wading. The initial point for soundings is the first tag on the barbed wire from the left cable support. The channel is straight for 600 feet above and below the station. The current is swift, and at high stages difficulty is experienced in keeping the meter in position on account of the high velocity and rough bed. The right bank is high and rocky, with a few trees. It probably will not overflow. The left bank is lower than the right, is covered in places with a growth of willows, and will overflow at flood stages. The bed of the stream is rough and rocky and is covered with large bowlders. There are two channels at all stages. The bench mark is a nail on an aspen tree 125 feet north of the gage. Its elevation is 8.93 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

[a] Gage heights at this station are only observed when visits are made by the hydrographer, so daily discharge measurements will have to be obtained by interpolation.

Discharge measurements of Uinta River near Whiterocks, Utah, in 1904.

Date.	Hydrographer.	Gage height.	Area of section.	Mean velocity.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Second-feet.*
March 15	H. S. Reed	0.80	46	2.28	105
March 15[a]	do	0.80	43	2.40	103
April 23	do	.95	49	2.49	122
May 27	do	2.12	113	5.77	652
May 27[a]	do	2.12	123	6.14	755
June 18	do	1.85	106	4.82	511
June 18[a]	do	1.85	111	5.35	594
August 29	do	1.25	59	3.95	233

[a] Made at bridge.

UINTA RIVER AT FORT DUCHESNE, UTAH.

This station was established September 14, 1899, by C. C. Babb. It is located at the highway bridge at the military post. The gage is a vertical rod 2 by 4 inches, 10 feet long, nailed to the old bridge abutment on the right bank 15 feet north of the bridge. This new rod was established April 19, 1904. It is read twice each day by Fred. Hoeft. Discharge measurements are made at high water from the bridge, and at ordinary stages by wading at a point 200 feet below. When measurements are made from the bridge the initial point for soundings is a zero marked on the west end of the bridge stringer on the downstream side. At the wading section the initial point is the first tag on the wire on the right bank. A tagged wire is stretched just below the bridge. The channel is curved both above and below the station and makes a half circle at the gaging section. The current is sluggish near the left bank, but is swift near the right bank. Both banks are low and subject to overflow. The right bank is covered with a heavy undergrowth. The bed of the stream is rocky, though at times the section is filled in with sediment brought down by Deep Creek during floods. Bench mark No. 1 is the head of a nut in the extreme southwest end of the upper stringer of the bridge. Its elevation above gage datum is 8.91 feet, and 4,994.00 feet above sea level, Evanston datum. Bench mark No. 2 is a large nail below a line of nails driven into a scarp cut into a large cottonwood tree situated on the left bank about 300 feet from the east end of the bridge. Its elevation above gage datum is 9.90 feet, and 4,994.99 feet above sea level, Evanston datum.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Uinta River at Fort Duchesne, Utah, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 2	H. S. Reed	47	66	2.12	2.73	140
March 12 [a]	do	40	46	1.04	2.41	48
March 17 [a]	do	47	54	1.43	2.55	77
March 26 [a]	do	40	41	.80	2.35	33
April 15 [a]	do	48	60	1.85	2.65	111
April 18 [a]	do	48	56	1.73	2.60	97
April 18 [b]	do	67	73	1.14	2.60	83
April 19 [a]	do	48	58	1.76	2.63	103
April 19 [b]	do	67	76	1.14	2.63	87
April 23 [b]	Reed and Murphy	64	68	1.03	2.57	70
April 30 [b]	H. S. Reed	70	88	1.73	2.85	152
May 20 [c]	Reed and Curtis	54	268	5.22	4.68	1,399
May 21 [c]	do	54	258	4.94	4.60	1,274
June 1 [c]	H. S. Reed	54	247	3.96	4.20	977
June 13 [c]	do	54	232	2.82	3.90	655
June 14 [d]	do	54	238	3.25	4.00	773
June 14 [e]	do	54	237	3.40	4.00	805
June 22 [e]	do	54	225	2.39	3.65	537
June 22 [d]	do	54	226	2.28	3.65	516
July 8 [a]	do	75	97	3.32	3.20	322
July 8 [b]	do	80	121	2.46	3.20	298
July 13 [a]	do	72	87	2.49	3.00	217
July 13 [b]	do	76	100	1.99	3.00	199
July 14 [e]	do	53	194	.99	2.93	192
July 14 [d]	do	53	191	1.00	2.93	191
July 14 [a]	do	64	81	2.43	2.93	197
July 14 [b]	do	76	98	1.85	2.93	181
August 1 [b]	do	68	87	1.55	2.81	135
August 1 [a]	do	52	68	2.16	2.81	147
August 22 [b]	do	68	82	1.48	2.75	121
August 22 [a]	do	50	64	2.09	2.75	134
September 10 [a]	do	48	56	1.66	2.65	93
September 10 [b]	do	67	73	1.22	2.65	89
November 3 [a]	do	50	58	2.49	2.80	144
November 4 [a]	do	50	52	2.21	2.75	115
November 4 [b]	do	68	80	1.36	2.75	109

[a] Measurement made by wading at old upper or 1903 section.
[b] Measurement made by wading at new lower or 1904 section.
[c] Made from bridge.
[d] Made from bridge, using 5-foot sections.
[e] Made from bridge, using 2-foot sections.

Mean daily gage height, in feet, of Uinta River at Fort Duchesne, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	(a)	2.73	2.60	2.89	4.10	3.20	2.80	2.82	2.80	2.90	2.72
2	(a)	(a)	2.70	2.60	2.91	4.08	3.20	2.79	2.75	2.80	2.90	2.70
3	(a)	(a)	2.70	2.58	2.92	3.98	3.08	2.75	2.72	2.79	2.90	2.70
4	(a)	(a)	2.70	2.60	2.90	3.90	3.01	2.72	2.73	2.78	2.89	(a)
5	(a)	(a)	2.69	2.60	2.88	3.82	3.10	2.70	2.78	2.78	2.89	(a)
6	(a)	(a)	2.68	2.58	2.83	3.78	3.09	2.69	2.74	2.88	2.89	(a)
7	(a)	(a)	2.65	2.55	2.86	3.85	3.17	2.69	2.72	2.90	2.89	(a)
8	(a)	(a)	2.65	2.52	2.91	4.15	3.18	2.66	2.70	2.89	2.89	(a)
9	(a)	(a)	2.65	2.50	2.95	3.98	3.12	2.64	2.69	2.92	2.90	(a)
10	(a)	(a)	2.62	2.50	3.16	3.90	3.08	2.60	2.67	2.90	2.89	(a)
11	(a)	(a)	2.53	2.58	3.40	3.95	3.05	2.75	2.65	2.90	2.88	(a)
12	(a)	(a)	2.51	2.63	3.78	4.04	3.00	2.70	2.66	2.99	2.85	(a)
13	(a)	(a)	2.50	2.65	4.00	3.95	2.98	2.80	2.68	2.95	2.85	(a)
14	(a)	(a)	2.52	2.65	4.35	3.90	2.95	2.80	2.68	2.95	2.85	(a)
15	(a)	(a)	2.56	2.65	4.44	3.85	2.91	2.82	2.68	2.95	2.85	(a)
16	(a)	(a)	2.61	2.62	4.38	3.75	2.90	2.85	2.68	2.95	2.85	(a)
17	(a)	(a)	2.60	2.60	4.32	3.80	2.87	2.98	2.67	2.93	2.85	(a)
18	(a)	(a)	2.58	2.60	4.55	3.78	2.86	3.00	2.68	2.91	2.85	(a)
19	(a)	(a)	2.60	2.61	4.70	3.74	2.83	2.96	2.68	2.91	2.85	(a)
20	(a)	(a)	2.60	2.61	4.70	3.68	2.82	2.85	2.70	2.91	2.85	(a)
21	(a)	(a)	2.58	2.59	4.70	3.61	2.82	2.80	2.82	2.90	2.85	(a)
22	(a)	(a)	2.45	2.59	4.55	3.59	2.80	2.78	2.82	2.90	2.85	(a)
23	(a)	(a)	2.45	2.59	5.15	3.58	2.79	2.75	2.89	2.90	2.85	(a)
24	(a)	(a)	2.45	2.59	5.35	3.58	2.79	2.80	2.89	2.90	2.85	(a)
25	(a)	(a)	2.42	2.59	5.15	3.55	2.96	2.79	2.87	2.90	2.83	(a)
26	(a)	(a)	2.41	2.69	4.78	3.38	2.84	2.79	2.86	2.90	2.80	(a)
27	(a)	(a)	2.48	2.69	4.45	3.31	2.80	2.82	2.85	2.90	2.77	(a)
28	(a)	2.80	2.50	2.73	4.33	3.29	2.80	2.85	2.84	2.90	2.77	(a)
29	(a)	2.73	2.68	2.84	4.30	3.20	2.92	2.86	2.80	2.90	2.75	(a)
30	(a)	.....	2.65	2.86	4.18	3.20	2.87	2.84	2.80	2.90	2.75	(a)
31	(a)	.....	2.60	.....	4.12	.....	2.83	2.88	.....	2.90	.....	(a)

a River frozen over.

Rating table for Uinta River at Fort Duchesne, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	44	2.85	167	3.60	523	4.50	1,210
2.45	55	2.90	184	3.70	586	4.60	1,297
2.50	67	2.95	201	3.80	653	4.70	1,385
2.55	80	3.00	219	3.90	724	4.80	1,475
2.60	93	3.10	259	4.00	799	4.90	1,565
2.65	107	3.20	304	4.10	878	5.00	1,655
2.70	121	3.30	353	4.20	959	5.10	1,745
2.75	136	3.40	406	4.30	1,041	5.20	1,835
2.80	151	3.50	463	4.40	1,125	5.30	1,930

The above table is applicable only for open-channel conditions. It is based upon 19 discharge measurements made during 1904 and is well defined. In the preparation of this table measurements made at the new or 1904 wading section and measurements at the bridge using 5-foot verticals have been discarded.

Estimated monthly discharge of Uinta River at Fort Duchesne, Utah, for 1904.

[Drainage area, 672 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	130	46	89.3	5,491	0.133	0.153
April	170	67	99.0	5,891	.147	.164
May	1,980	161	966	59,400	1.44	1.66
June	918	304	627	37,310	.933	1.04
July	304	148	207	12,730	.308	.355
August	219	93	149	9,162	.222	.256
September	181	107	137	8,152	.204	.228
October	215	145	182	11,190	.271	.312
November	184	136	168	9,997	.250	.279
December 1–3	127	121	123	732	.183	.020
The period				160,100		

UINTA RIVER AT OURAY SCHOOL, UTAH.

This station was established November 8, 1899, by C. C. Babb. It is located at the highway bridge 5 miles below the station at Fort Duchesne. The original gage was a vertical 1 by 5 inch board, 9 feet long, nailed to the east side of the south crib of the bridge. On April 20, 1904, a new gage rod was installed on the north crib, the zero of which is 1 foot below the datum of the old gage. It is read twice each day by O. N. Waddell, the superintendent of the school. Discharge measurements are made at high stages from the bridge and at ordinary stages by wading about 200 feet below. The initial point for soundings for the section at the bridge is the zero mark on the bridge railing. The initial point for the wading section is the first tag from the right bank on the tagged wire. The channel is curved above the bridge and is straight for 600 feet below. The right bank is high, is composed of gravel, and is not subject to overflow. The left bank is low and will overflow at high stages. The bed of the stream is rocky and is filled in with sediment during a part of the year. The central pier of the bridge divides the bridge section into two parts. Bench mark No. 1 is the center one of the line of nails driven in a cottonwood tree at the northwest corner of the bridge. Its elevation is 8.48 feet above the zero of the gage. Bench mark No. 2 is a nail in the flagstaff in the school grounds. Its elevation is 23.64 feet above the zero of the gage and 4,760 feet above sea level.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Uinta River at Ouray School, Utah, for 1904.

Date	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 18[a]	H. S. Reed	53	52	1.38	1.37	72
April 14[a]	do	56	69	1.67	1.55	115
April 20[a]	do	55	66	1.47	1.48	97
April 25[a]	Reed and Murphy	49	50	1.20	1.33	60
May 20	H. S. Reed	66	236	5.46	4.15	1,289
July 14[a]	do	64	84	1.94	1.92	163
August 17[a]	do	80	120	2.42	2.43	291
September 5[a]	do	62	68	1.59	1.65	108
October 31[a]	do	60	72	1.57	1.67	113

[a] Measurement made by wading at different section.

Mean daily gage height,[a] in feet, of Uinta River at Ouray School, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[b]
1	.....	1.42	1.90	3.78	2.45	1.65	2.01	1.80	1.70	1.43
2	.....	1.50	1.93	3.68	2.40	1.60	2.09	1.80	1.70	1.42
3	.....	1.48	1.98	3.55	2.30	1.50	1.72	1.79	1.68	1.44
4	.....	1.40	1.98	3.26	2.30	1.50	1.88	1.80	1.62	1.49
5	.....	1.40	1.86	3.10	2.25	1.45	1.78	1.78	1.62	1.52
6	.....	1.35	1.76	3.08	2.20	1.40	1.69	1.79	1.61	1.55
7	.....	1.38	1.78	3.15	2.25	1.40	1.61	1.81	1.60	1.58
8	.....	1.32	1.82	3.35	2.35	1.35	1.58	1.78	1.60	1.71
9	.....	1.30	1.91	3.46	2.30	1.40	1.51	1.80	1.64	1.80
10	.....	1.28	2.39	3.49	2.15	1.25	1.52	1.79	1.55	.....
11	.....	1.40	2.80	3.50	2.00	1.70	1.50	1.82	1.58	.....
12	.....	1.42	3.48	3.50	2.00	1.50	1.48	1.81	1.52	.....
13	.....	1.42	3.68	3.48	2.00	1.40	1.51	1.80	1.52	.....
14	.....	1.50	4.02	3.40	1.90	2.35	1.49	1.81	1.52	.....
15	1.32	1.50	4.35	3.40	1.80	1.70	1.52	1.80	1.52	.....
16	1.35	1.50	4.15	3.40	1.80	2.15	1.52	1.80	1.51	.....
17	1.30	1.40	4.25	3.39	1.80	1.95	1.52	1.80	1.49	.....
18	1.30	1.40	4.65	3.08	1.70	2.19	1.52	1.80	1.43	.....
19	1.30	1.40	4.50	3.00	1.65	2.20	1.52	1.79	1.43	.....
20	1.30	1.46	4.50	3.00	1.60	1.99	1.50	1.80	1.42	.....
21	1.30	1.47	4.25	3.00	1.60	2.15	1.51	1.80	1.40	.....
22	1.30	1.42	4.00	2.95	1.60	1.76	1.68	1.80	1.40	.....
23	1.30	1.36	4.65	2.85	1.55	1.70	1.90	1.79	1.40	.....
24	1.32	1.32	5.25	2.75	1.65	1.78	1.78	1.77	1.41	.....
25	1.30	1.31	4.90	2.65	1.90	1.99	1.77	1.75	1.40	.....
26	1.30	1.30	4.40	2.60	1.70	1.78	1.72	1.72	1.43	.....
27	1.35	1.42	4.00	2.50	1.60	1.90	1.76	1.72	1.50	.....
28	1.45	1.49	3.90	2.45	1.60	1.95	1.71	1.72	1.40	.....
29	1.58	1.82	4.00	2.45	1.80	1.98	1.73	1.70	1.41	.....
30	1.45	1.90	3.90	2.35	1.75	1.90	1.78	1.70	1.41	.....
31	1.40	.....	3.80	.....	1.70	1.96	.....	1.70	.....	.....

[a] Gage heights referred to new datum.

[b] Ice during December.

Rating table for Uinta River at Ouray School, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.25	58	1.85	154	2.90	452	4.10	1,240
1.30	64	1.90	164	3.00	495	4.20	1,340
1.35	70	1.95	174	3.10	540	4.30	1,440
1.40	77	2.00	184	3.20	590	4.40	1,540
1.45	84	2.10	206	3.30	640	4.50	1,650
1.50	92	2.20	230	3.40	700	4.60	1,760
1.55	100	2.30	256	3.50	760	4.70	1,870
1.60	108	2.40	284	3.60	830	4.80	1,980
1.65	117	2.50	313	3.70	900	4.90	2,090
1.70	126	2.60	344	3.80	980	5.00	2,210
1.75	135	2.70	377	3.90	1,060	5.10	2,330
1.80	144	2.80	413	4.00	1,150	5.20	2,450

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904. It is not well defined. The table has been extended above gage height 4.15 feet.

Estimated monthly discharge of Uinta River at Ouray School, Utah, for 1904.

[Drainage area, 967 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 15–31	105	64	70.5	2,377	0.073	0.046
April	164	62	83.2	4,951	.086	.096
May	2,510	137	972	59,770	1.01	1.16
June	964	270	577	34,330	.597	.666
July	298	100	174	10,700	.180	.208
August	270	58	141	8,670	.146	.168
September	204	89	120	7,140	.124	.138
October	148	126	140	8,608	.145	.167
November	126	77	94.7	5,635	.098	.109
The period				142,200		

WHITEROCKS RIVER NEAR WHITEROCKS, UTAH.[a]

This station was established September 15, 1899, by C. C. Babb. It is located at the mouth of the canyon at the foot of the "dug way" leading to the river bottom from the plateau above. It is 10 miles above the Indian agency at Whiterocks, which is the nearest settlement. The gage is an inclined 2 by 4 inch timber, 12 feet long, bolted to the triple trunk of a tree on the left bank 200 feet below the gaging section. Discharge measurements are made at high stages by means of a cable and car located 200 feet above the gage rod. At ordinary stages measurements are made by wading. The initial point for soundings is the tree to which the cable is fastened on the right bank. The channel is straight for 150 feet above and for 300 feet below the cable. The current is swift. Both banks are of medium height and are covered with a thick growth of trees and underbrush. The bed of the stream is rough and rocky and is covered with large bowlders. The bed is permanent, but it is hard to get accurate soundings on account of its roughness. The bench mark is a nail in a burnt aspen tree 50 feet east of the gage. Its elevation is 10.12 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Whiterocks River near Whiterocks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 16	H. S. Reed	28.0	1.32	0.55	37
April 24	do	28.0	1.57	.70	44
May 28	do	87.0	5.07	2.00	441
June 19	do	71.0	3.61	1.65	256
August 30	do	45.0	2.62	1.10	118

[a] Gage heights at this station are only observed when visits are made by the hydrographer, so daily discharge measurements will have to be obtained by interpolation.

DUCHESNE RIVER NEAR MYTON, UTAH.

This station was established October 26, 1899, by C. C. Babb. It is located at the highway bridge, on the road from Fort Duchesne to Price, Utah, 14 miles from Fort Duchesne. It is 3 miles below the mouth of Lake Creek. The gage is a vertical 2 by 5 inch timber, 12 feet long, nailed to the south side of the west abutment. It is read twice each day by H. Calvert, the storekeeper at Myton, Utah. Discharge measurements are made at all stages from the two-span highway bridge to which the gage is attached. The initial point for soundings is the extreme east end of the bridge stringer. The channel is straight for 100 feet above and for 500 feet below the bridge. The current is sluggish at ordinary stages. The right bank is high, without trees, and will not overflow. The left bank is lower than the right, is covered with underbrush and trees, and will overflow at extreme flood stages. The bed of the stream is sandy and somewhat shifting. The channel is divided into two parts by the center pier of the bridge. The bench mark is a nail in the northwest corner of the store. Its elevation is 15.72 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Duchesne River near Myton, Utah, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 10	H. S. Reed	97	392	0.84	5.30	330
June 20	do	108	786	4.78	8.20	3,756
June 21	do	107	756	4.24	7.93	3,202
July 1	do	105	638	2.63	6.90	1,685
July 25	do	105	501	1.62	6.04	814
August 31	do	103	521	1.39	5.82	724
September 1	do	102	504	1.16	5.67	586
September 25	do	97	466	.83	5.32	385
September 25	do	97	468	.77	5.32	361

Mean daily gage height, in feet, of Duchesne River near Myton, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.29	6.37	8.45	6.95	5.72	5.65	5.30	5.28	5.2
2	.....	5.27	6.45	8.55	6.95	5.70	5.50	5.30	5.28	5.2
3	.....	5.23	6.30	8.30	6.80	5.70	5.40	5.30	5.25	5.2
4	.....	5.22	6.30	7.95	6.70	5.68	5.40	5.28	5.25	5.2
5	.....	5.25	6.34	7.85	6.60	5.60	5.36	5.28	5.25	5.2
6	.....	5.30	6.33	7.80	6.55	5.52	5.31	5.28	5.22	5.2
7	.....	5.28	6.30	8.10	6.65	5.50	5.30	5.40	5.22	.....
8	.....	5.28	6.60	8.40	6.50	5.50	5.30	5.40	5.22	.....
9	.....	5.28	6.49	8.40	6.45	5.50	5.30	5.49	5.20	.....
10	5.30	5.28	6.49	8.35	6.40	5.50	5.30	5.46	5.20	.....
11	5.27	5.34	6.80	8.65	6.25	5.75	5.25	5.44	5.20	.....
12	5.21	5.49	6.96	8.85	6.20	5.65	5.20	5.50	5.20	.....
13	5.20	5.73	7.04	8.85	6.20	5.70	5.20	5.50	5.20	.....
14	5.25	5.90	7.28	8.70	6.20	5.72	5.20	5.50	5.20	.....
15	5.26	6.01	7.49	8.60	6.10	5.75	5.20	5.48	5.20	.....
16	5.21	6.10	7.59	8.30	6.10	5.75	5.11	5.47	5.25	.....
17	5.19	6.08	7.70	8.20	6.00	5.78	5.20	5.44	5.33	.....
18	5.20	6.15	7.95	8.15	6.00	5.80	5.20	5.41	5.30	.....
19	5.21	6.21	8.14	8.00	5.91	5.70	5.20	5.35	5.25	.....
20	5.25	6.15	8.20	8.10	5.90	5.60	5.25	5.28	5.22	.....
21	5.29	6.10	8.20	7.96	5.82	5.50	5.30	5.28	5.26	.....
22	5.23	6.20	8.17	7.86	5.80	5.45	5.35	5.29	5.28	.....
23	5.20	5.98	8.65	7.69	5.70	5.40	5.40	5.30	5.29	.....
24	5.20	5.88	9.30	7.59	5.90	5.45	5.35	5.30	5.33	.....
25	5.23	5.82	9.50	7.45	6.00	5.45	5.30	5.30	5.37	.....
26	5.25	5.88	9.35	7.25	6.00	5.45	5.30	5.30	5.33	.....
27	5.21	6.06	8.95	7.15	5.85	5.48	5.30	5.30	5.29	.....
28	5.20	6.39	8.30	7.05	5.80	5.65	5.30	5.30	5.28	.....
29	5.27	6.37	8.30	7.05	5.85	5.85	5.30	5.30	5.38	.....
30	5.37	6.43	8.30	7.00	5.90	7.15	5.30	5.30	5.35	.....
31	5.33	.....	8.30	.....	5.80	6.20	.....	5.30	.....	.....

Rating table for Duchesne River near Myton, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Seco d-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second feet.*
5.10	264	6.00	840	7.20	2,150	8.40	4,070
5.15	288	6.10	920	7.30	2,290	8.50	4,250
5.20	313	6.20	1,005	7.40	2,430	8.60	4,430
5.25	339	6.30	1,100	7.50	2,575	8.70	4,610
5.30	366	6.40	1,200	7.60	2,725	8.80	4,790
5.35	394	6.50	1,305	7.70	2,880	8.90	4,970
5.40	423	6.60	1,415	7.80	3,040	9.00	5,150
5.45	453	6.70	1,530	7.90	3,205	9.10	5,330
5.50	484	6.80	1,650	8.00	3,375	9.20	5,510
5.60	548	6.90	1,770	8.10	3,545	9.30	5,700
5.70	615	7.00	1,890	8.20	3,715	9.40	5,890
5.80	685	7.10	2,020	8.30	3,890	9.50	6,080
5.90	760						

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904. It is fairly well defined between gage heights 5.30 feet and 8.20 feet. The table has been extended above gage height 8.20 feet.

Estimated monthly discharge of Duchesne River near Myton, Utah, for 1904.

[Drainage area, 2,746 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 10–31	406	308	335	14,620	0.122	0.100
April	1,230	323	691	41,120	.252	.281
May	6,080	1,100	2,856	175,600	1.04	1.20
June	4,880	1,890	3,454	205,500	1.26	1.41
July	1,830	615	1,031	63,390	.375	.432
August	2,085	423	623	38,310	.227	.262
September	581	269	369	21,930	.134	.150
October	484	355	401	24,660	.146	.168
November	411	313	346	20,590	.126	.141
The period				605,700		

DUCHESNE RIVER (WEST FORK) ABOVE FORKS, UTAH.

This station was established May 26, 1904, by C. Tanner. It is located 3 miles above the forks of Duchesne River. The original gage was a vertical staff, graduated to feet and tenths, driven into the bed of the stream and firmly braced. An inclined staff gage, graduated to read directly to feet and tenths, was established October 8, 1904, the datum being 0.78 feet below that of the vertical gage. Gage readings are taken about twice a week by Frank Thomas. Discharge measurements are made by means of a cable and car. The initial point for soundings is the first ring of fine wire around the cable at the right bank. The channel is straight for about 200 feet above and 100 feet below the station. The current is swift. The right bank is high, wooded, and is not liable to overflow. The left bank is low, wooded, and subject to overflow during high water. The bed of the stream is composed of clean sand, gravel, and rock, and is permanent. There is but one channel at all stages. The conditions are favorable to accurate measurements. The bench mark is the head of a one-fourth inch bolt driven into the south face of a large pine tree about 85 feet northwest of the gage rod. The tree is blazed above the bolt head, and marked "B. M. 6.56" with nails driven into the tree. Its elevation is 6.56 feet above the zero of the inclined gage and 5.78 feet above the zero of the vertical gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Duchesne River (West Fork) above forks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
May 26	C. Tanner	76	4.29	1.50	327
May 30	do	67	4.07	1.30	27[illegible]
June 6	F. Thomas	57	3.95	1.05	225
June 16	C. Tanner	49	3.44	.80	16[illegible]
June 26	do	37	2.66	.45	9[illegible]
July 12	F. Thomas	28	2.11	.20	6[illegible]
July 18	do	27	1.67	.15	44
August 3	do	22	1.46	.00	[illegible]
August 16	do	21	1.40	.00	[illegible]
October 8	C. Tanner	18	1.20	—.07	[illegible]

Mean daily gage height, in feet, of Duchesne River (West Fork) above forks, Utah, for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1						
2						
3				0.00		
4						
5						
6		1.05				
7						
8						−0.07
9						
10						
11						
12			0.20			
13		1.00				
14						
15						
16		.80		.00		
17		.80				
18			.15			
19						
20						
21						
22						
23						
24				−.05		
25						
26	1.50	.45				
27						
28		.40				
29						
30	1.30		.05			
31						

DUCHESNE RIVER (NORTH FORK) ABOVE FORKS, UTAH.

This station was established May 28, 1904, by C. Tanner. It is located 1 mile above the forks of Duchesne River. The original gage was a vertical staff, graduated to feet and tenths, driven into the bed of the river near the right bank. An inclined-staff gage, reading directly to feet and tenths, was established October 6, 1904, at the same elevation as the vertical gage. The gage is read about twice a week by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first metallic tag on the tagged wire at the left bank. The channel is straight for about 200 feet above and 500 feet below the station. The current is swift. The banks are not liable to overflow. The bed of the stream is composed of large bowlders, and is permanent. There is but one channel at all stages. The roughness of the stream bed gives large inaccuracies in determining depth, and endangers the meter when attempting to secure bottom velocities during high stages. Bench mark No. 1 is the "Knob" in the northeast quadrant of a cross cut in a limestone ledge about 100 feet southwest of the gage rod, marked by the words "Bench mark" chiseled into the face of the cliff to the north of the cross. Its elevation is 8.39 feet above the zero of the gage. Bench mark No. 2 is the head of a bolt driven into the root of the pine tree to which the cable and gage rods are fastened. It is marked "Bench mark 5.11." Its elevation is 5.11 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Duchesne River (North Fork) above forks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 28	C. Tanner	148	5.18	2.50	765
June 19	do	157	5.46	2.65	860
June 26	do	119	3.50	2.00	415
July 12	F. Thomas	96	2.96	1.40	283
July 19	do	82	2.38	1.20	196
August 3	do	72	1.84	1.00	133
August 16	do	64	1.80	.95	116
October 7 [a]	C. Tanner	49	1.06	.76	52

[a] Measurement made 200 yards above cable station.

Mean daily gage height, in feet, of Duchesne River (North Fork) above forks, Utah, for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1						
2						
3				1.00		
4						
5						0.71
6		2.40				
7				.95		.76
8						
9						.74
10						
11						
12			1.40			
13		3.10		.95		
14						
15						
16				.95		
17		2.50				
18						
19		2.65	1.20			
20						
21						
22						
23						
24				.90		
25						
26	2.80	2.00				
27	2.70					
28	2.50	1.95				
29	2.50					
30			1.00			
31						

ROCK CREEK (EAST CREEK) 10 MILES ABOVE MOUTH, UTAH.

This station was established May 17, 1904, by H. S. Reed. It was originally located at the footbridge at the ford where the Indian trail up Farm Creek to Whiterocks, Utah, crosses Rock Creek, about 8½ miles above the junction of Rock Creek with the Duchesne River. A plain staff gage was fastened to the left abutment of the bridge, and discharge measurements were made from the footbridge. Bench marks for this gage were established as follows: No. 1 is a nail in the bridge stringer back of the gage rod. Its elevation is 6.33 feet above the zero of the gage. Bench mark No. 2 is the highest point on bowlder 15 feet southeast from the gage. Its elevation is 6.87 feet above the zero of the gage. Bench mark No. 3 is a nail in a stump 55 feet west of the gage rod at the west end of the bridge. Its elevation is 6.50 feet above the zero of the gage.

The station was reestablished June 21, 1904, by C. Tanner, at approximately the 7,500 foot contour, about 10 miles above the mouth

of the creek, 1½ miles above the original location. The new gage is a plain staff, graduated to feet and tenths, driven into the bed of the stream and firmly braced. It is read twice each week by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first metal tag on the tagged wire at the left bank. The channel is straight for 500 feet above and 400 feet below the station. The current is swift. The right bank is low, and liable to overflow during high water. The left bank is high, rocky, and not subject to overflow. The bed of the stream is composed of rock, free from vegetation, and is permanent. There is but one channel at all stages. The chief inaccuracy is developed by the uneven bed. No bench marks have as yet been established for the new gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Rock Creek (East Creek) 10 miles above mouth, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
May 17	H. S. Reed	89	6.47	2.80	57[illegible]
May 18	do	104	7.35	3.20	7[illegible]
June 21	C. Tanner	232	4.00	3.60	[illegible]
June 25	do	206	3.04	3.25	[illegible]
July 20	F. Thomas	135	1.79	2.50	241
August 14	do	128	1.32	2.20	1[illegible]
September 26	C. Tanner	100	.85	2.11	[illegible]
October 4	do	100	.73	2.07	[illegible]

Mean daily gage height, in feet, of Rock Creek (East Creek) 10 miles above mouth, Utah, for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1						17	2.80					
2						18	3.20					
3						19		3.80				
4					2.07	20		3.60	2.50			
5				2.15	2.07	21		3.60				
6						22						
7						23				2.20		
8						24						
9						25		3.25				
10						26					2.11	
11						27						
12						28						
13						29						
14			2.20			30						
15						31				2.20		
16												

STRAWBERRY RIVER IN STRAWBERRY VALLEY, UTAH.

This station was established May 12, 1903, by C. Tanner. The original gage was a vertical staff, graduated to feet and tenths, driven into the bed of the river 100 feet below the junction of Big and Little Strawberry rivers. A new gage was installed June 2, 1904, one-half mile below the junction. It is a vertical staff, graduated to feet and tenths, driven into the bed of the river and securely braced. The gage is read twice a week by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first metal tag on the tagged wire at the left bank. The channel is straight for about 600 feet above and 400 feet below the station. The current is sluggish. Both banks are wooded and not liable to overflow. The bed of the stream is composed of gravel, somewhat moss-grown, and permanent. There is but one channel at all stages. The vegetation in the bed of the stream may affect both gage heights and gagings at low water. No bench marks have been established, but the relation between the two gages has been established by simultaneous readings.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Strawberry River in Strawberry Valley, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 22	C. Tanner	108	3.88	2.95	420
June 1	do	84	3.06	2.25	257
June 10	F. Thomas	86	1.64	(2.20) 1.80	141
June 15	C. Tanner	78	1.67	(1.97) 1.50	131
June 28	do	61	1.31	(1.75) 1.17	79
July 9	F. Thomas	61	1.07	(1.75) 1.00	64
July 17	do	60	.93	(1.75) .95	56
August 26	do	30	1.17	(1.95) .95	35
September 22	C. Tanner	26	1.03	.98	27

NOTE.—Gage heights in parentheses are taken from the new gage rod at cable section, which are of no value in season of growing moss, as gage reading does not fall as creek diminishes in volume.

Estimated monthly discharge[a] of Strawberry Creek in Strawberry Valley, Utah, for 190[illegible]

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	27	27	27	1,6[illegible]
February	27	27	27	1,5[illegible]
March	27	27	27	1,6[illegible]
April	224	27	97	5,771
May	472	230	372	22,870
June	257	74	145	8,627
July	74	48	58	3,568
August	48	34	40	2,459
September	33	27	29	1,725
October	27	27	27	1,660
November	27	27	27	1,606
December	27	27	27	1,660
The year	472	27	75	54,820

[a] Estimated by C. Tanner from meter measurements, interpolated gage heights, and temperature records.

CURRANT CREEK 13 MILES ABOVE MOUTH, UTAH.

This station was established May 23, 1904, by C. Tanner. It is located 13 miles above the junction of Deep and Currant creeks. A plain staff gage graduated to feet and tenths is driven into the bed of the stream. It is read twice each week by Frank Thomas. Discharge measurements are made by wading near the gage. The initial point for soundings is the first tag of the tagged wire at the left bank. The channel is straight for about 150 feet above and 50 feet below the station. The current is swift. The banks of the stream are about 2 feet high, covered with willows, and are liable to overflow. The bed of the stream is composed of bowlders and gravel. It is rough and permanent. There is but one channel at all stages.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Currant Creek 13 miles above mouth, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 23	C. Tanner	62	3.02	2.80	186
September 24	do	11	.68	.90	8

CURRANT CREEK 3 MILES ABOVE MOUTH, UTAH.

This station was established April 4, 1904, by C. Tanner. It is located at the road crossing 3 miles above the junction of Deep and Currant creeks. A plain staff gage, graduated to feet and tenths, is driven firmly into the bed of the stream and securely braced. It is read twice each week by Frank Thomas. Discharge measurements are made by wading near the gage. The initial point for soundings is a blazed stake driven into the left bank about 15 feet below the gage rod. The channel is straight for about 200 feet above and 75 feet below the station. The current is swift. The right bank is wooded and overflows only during extremely high water. The left bank is high, wooded, and not subject to overflow. The bed of the stream is composed of coarse gravel, free from vegetation, and is liable to shift at high water. There is but one channel at all stages.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Currant Creek 3 miles above mouth, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 4	C. Tanner	17	1.90	1.43	32
May 23	do	52	3.87	2.33	202
May 31	do	45	3.57	2.13	159
June 16	do	33	2.83	1.88	94
June 27	do	28	2.29	1.70	65
July 11	F. Thomas	22	2.10	1.50	46
August 4	do	16	1.40	1.35	23
September 25	C. Tanner	16	1.03	1.37	16

Mean daily gage height, in feet, of Currant Creek 3 miles above mouth, Utah, for 190

Day.	Apr.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sep
1						17					
2						18					
3						19					
4	1.43			1.35		20					
5						21			1.45		
6						22					
7						23	2.33				
8						24					1.8
9						25					1.7
10			1.50			26				1.30	
11			1.50			27		1.70			
12						28		1.70			
13						29					
14			1.50			30					
15						31	2.13				
16		1.88									

LAKE FORK (WEST FORK) 10 MILES ABOVE FORKS, UTAH.

This station was established May 16, 1904, by H. S. Reed. It is located at the outlet of the lower lake on the West Fork, 10 miles above the forks of Lake Fork. It is at approximately the 8,500-foot contour. Whiterocks Indian Agency, the nearest post-office, is about 50 miles distant. Fort Duchesne is about 50 miles to the southeast. The original gage was a vertical staff driven into the bed of the stream and braced to a pine tree on the right bank. An inclined staff gage, reading directly to feet and tenths, was established September 30, 1904, by C. Tanner, at the same elevation as the vertical gage. The gage is read by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire at ordinary stages and by wading during low water. The channel is straight for 300 feet above and 150 feet below the station. The current is sluggish above and swift below the station. Both banks are high, wooded, and not liable to overflow. The bed of the stream is rocky, free from vegetation, and permanent. There is but one channel at all stages. Bench mark No. 1 is the head of a one-fourth inch bolt driven into the north side of the red pine tree which forms the cable support on the right bank. The tree is blazed above the bolt and marked "U. S. G. S. Gage B. M. 8.43." Its elevation is 8.43 feet above the zero of the gage. Bench mark No. 2 is the head of a 30-penny nail driven into the root of a pine tree 45 feet south of bench mark No. 1. Its elevation is 4.25 feet above the zero of the gage. Bench mark No. 3 is the head of a 30-penny nail 2 feet above the ground, driven into the east side of a pine tree 25 feet west of bench mark No. 1. It is marked

"U. S. G. S. B. M. Elevation, 10.38." Its elevation is 10.38 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Lake Fork (West Fork) 10 miles above forks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 16	H. S. Reed	155	1.99	2.30	309
June 29	do	156	2.20	2.33	344
September 1	F. Thomas	97	1.21	1.35	117
September 29	C. Tanner	66	.85	1.10	56

NOTE.—For measurements made of a small creek entering the lake above the station see miscellaneous measurements.

LAKE FORK (EAST FORK) 8 MILES ABOVE FORKS, UTAH.

This station was established May 14, 1904, by H. S. Reed. It is located 8 miles above the forks of Lake Fork, 1 mile below the upper Indian camp on the East Fork, at approximately the 7,500-foot contour. Whiterocks Indian Agency, the nearest post-office, is about 40 miles distant, and Fort Duchesne is about 45 miles to the northeast. The original gage was a plain staff driven into the bed of the stream and braced to an overhanging stump on the left bank. An inclined gage, reading directly to feet and tenths, was established October 2, 1904, by C. Tanner, at the same elevation as the vertical gage. The gage is read by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first metal tag on the tagged line at the right bank. The channel is straight for about 300 feet above and 200 feet below the station. The current is swift. The right bank is low, wooded, and liable to overflow during high water. The left bank is high, wooded, and not subject to overflow. The bed of the stream is composed of bowlders, free from vegetation, and permanent. There is but one channel at all stages. Bench mark No. 1 is a bolt in the cable post on the right bank. Its elevation is 3.49 feet above the zero of the gage. Bench mark No. 2 is a cross chiseled in a large bowlder near the left end of the cable. It has an elevation of 6.39 feet above the zero of the gage, and is marked "U. S. G. S. B. M. 6.39." Bench mark No. 3 is the head of a 30-penny nail driven into the sawed stump of an aspen on the left bank. Its elevation is 8.52 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Lake Fork (East Fork) 8 miles above forks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 14[a]	H. S. Reed	91	2.91	1.40	265
June 28[a]	do	94	2.72	1.31	256
October 2	C. Tanner	64	1.33	.68	86

[a] Measurement made by wading.

LAKE FORK BELOW FORKS, UTAH.

This station was established June 23, 1904, by C. Tanner. It is located just below the forks of Lake Fork, on the trail from Spanish Fork to Whiterocks, Utah. A plain staff gage, graduated to feet and tenths, is driven vertically into the bed of the stream and securely braced. It is read twice a week by Frank Thomas. Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first metal tag on the tagged wire at the left bank. The channel is straight for about 400 feet above and below the station. The current is swift. The right bank is low, wooded, and liable to overflow during high water. The left bank is high, wooded, and is not subject to overflow. The bed of the stream is composed of large bowlders, free from vegetation, and is somewhat shifting. There is but one channel at all stages. The conditions are unfavorable to accurate measurement, but are the best that could be found.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Lake Fork below forks, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 24	C. Tanner	153	5.06	2.00	772
July 20	F. Thomas	109	3.38	1.00	369
August 14	do	106	3.34	1.00	355
September 1	do	96	2.93	.85	283
September 28	C. Tanner	70	2.38	.65	168

LAKE FORK NEAR ITS MOUTH, UTAH.

This station was established July 3, 1900, by C. T. Prall. It is located at the wagon bridge one-half mile above the mouth of the creek. It is 3 miles from the gaging station on Duchesne River at Price Road bridge and is 17 miles southwest of Fort Duchesne. The gage is a 1 by 4 inch vertical board, 9 feet long, nailed to the downstream side of the west abutment. During 1904 all discharge measurements were made from the bridge. There is a section 400 feet below the bridge at which measurements may be made by wading. The initial point for soundings is a point marked on the bridge floor at the edge of the east abutment on the right bank. The channel is straight for 75 feet above and for 200 feet below the station. The current is never swift except during flood stages. Both banks are high and are not subject to overflow. The bed of the stream is composed of cobblestones and there is but one channel at all stages. Bench mark No. 1 is a nail in the bridge abutment opposite the 4.5-foot mark on the gage rod. Bench mark No. 2 is a nail in the bridge upright directly over the gage rod. Its elevation is 10.59 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of H. S. Reed, resident hydrographer.

Discharge measurements of Lake Fork near its mouth, Utah, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 10	H. S. Reed	40	124	0.52	1.80	64
April 21	do	40	135	1.22	2.20	165
April 22	Reed and Murphy	40	138	1.13	2.15	156
May 19	H. S. Reed	40	234	4.80	4.30	1,123
June 20	do	40	247	4.98	4.32	1,230
June 21	do	40	234	4.78	4.15	1,119
July 1	do	40	182	3.31	3.25	603
July 25	do	40	154	2.10	2.60	324
August 31	do	40	160	2.44	2.80	391
August 31	do	40	143	2.09	2.60	299
September 26	do	40	134	1.28	2.23	171

RED CREEK ABOVE NARROWS, UTAH.

This station was established May 31, 1904, by C. Tanner. It is located above the narrows of Red Creek, about 10 miles above the point where the wagon road from Heber City to Fort Duchesne crosses Red Creek. A plain staff gage, graduated to feet and tenths, is driven into the bed of the stream and firmly braced. It is read twice a week by Frank Thomas.

Discharge measurements are made by wading near the gage. The initial point for soundings is a blazed stake on the left bank, to which one end of the tagged wire is fastened when the stream is gaged. The channel is straight for 35 feet above and 25 feet below the station. The current is sluggish above and swift below the station. Both banks are low, covered with a willow growth, and liable to overflow during high water. The bed of the stream is composed of clean sand and gravel and is fairly permanent. There is but one channel at all stages.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Red Creek above narrows, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean Velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 31	C. Tanner	15	1.80	2.40	27
June 6	F. Thomas	12	2.02	1.95	24
October 12	do	1.5	1.12	.60	2

PRICE RIVER NEAR HELPER, UTAH.

This station was established February 21, 1904, by Caleb Tanner. It is located on the upper side of the ford, near the settlement of Spring Glen, about 2½ miles south of the town of Helper, Utah, and about 350 feet west of the main line of the Denver and Rio Grande Railroad. A plain staff gage, graduated to feet and tenths, is driven vertically into the bed of the river. It is read once each day by Perry Miller. Discharge measurements are made by wading. The initial point for soundings is a 2 by 4 inch post driven into the slope of the left bank, south 8° west 21½ feet from the gage. The course of the section is north 44° west. At 71 feet on the section a 2 by 4 inch post is driven on the west bank of the river. The channel is straight for 125 feet above and 400 feet below the station. The current is swift. The right bank is a low, sloping bank of clay and sand. The left bank is high at the station, but 30 feet below turns away from the river, leaving a large area of low ground that is mostly covered during high water. The bed of the stream is composed of clean gravel and sand and fairly permanent, except near the east bank, where it is liable to shift. There is one channel at all stages. During extreme high water discharge measurements may have to be taken at the footbridge. Bench mark No. 1 bears south 65° east 23 feet from the gage, being a United States Geological Survey standard bench-mark cap set in cement on a sandstone bowlder embedded in the sloping bank, about 16 feet below the center of a small ditch. Its elevation is 12.55 feet above the zero of the gage, and is so marked upon the cap. Bench mark No. 2 bears south 86° east 19.2 feet from the gage, being a cross

chiseled on the sloping face of a large bowlder embedded in the sloping bank and marked "B. M." Its elevation is 11.19 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Price River near Helper, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 20	C. Tanner	23	1.08	3.33	25
April 1	W. P. Hardesty	45	1.51	3.63	68
June 11	W. Swendsen	105	2.55	4.32	268
September 2	C. Tanner	29	.94	3.43	27
December 6	W. Swendsen	3.3	1.41	3.20	5

Mean daily gage height, in feet, of Price River near Helper, Utah, for 1904.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.63	3.65	4.30	.....	3.75	3.50	3.50	3.40	3.35	3.40
2	.....	3.53	3.60	4.20	.....	3.75	3.55	3.50	3.40	3.35	3.40
3	.....	3.43	3.61	4.32	.....	3.75	3.45	3.50	3.40	3.30	3.40
4	.....	3.50	3.60	4.25	.....	3.65	3.45	3.50	3.40	3.30	3.40
5	.....	3.40	3.70	4.30	.....	3.65	3.45	3.50	3.40	3.30	3.40
6	.....	3.50	3.70	4.35	.....	3.65	3.45	3.50	3.40	3.30	3.40
7	.....	4.50	3.60	4.60	.....	3.60	3.45	3.60	3.40	3.30	3.30
8	.....	3.60	3.70	4.60	.....	3.70	3.45	3.50	3.40	3.30	3.25
9	.....	3.40	3.80	4.70	.....	3.60	3.40	3.50	3.40	3.30	3.30
10	.....	3.50	3.90	4.85	.....	3.55	3.40	3.50	3.45	3.30	3.30
11	.....	3.50	4.20	4.90	[b]4.30	3.50	3.40	3.50	3.50	3.30	3.30
12	.....	3.40	4.10	4.60	4.30	3.50	3.45	3.50	3.60	3.30	3.25
13	.....	3.40	4.10	4.60	4.25	3.55	3.55	3.50	3.50	3.30	3.25
14	.....	3.50	4.20	4.65	4.20	3.50	3.55	3.55	3.45	3.30	3.25
15	.....	3.40	4.40	4.70	4.20	3.55	3.55	3.50	3.50	3.30	3.25
16	.....	3.40	4.10	4.70	4.15	3.50	3.45	3.50	3.45	3.40	3.25
17	.....	3.40	4.10	4.70	4.15	3.50	3.50	3.45	3.45	3.45	3.25
18	.....	3.50	4.10	4.75	4.15	3.50	3.60	3.40	3.40	3.40	3.25
19	.....	3.50	4.20	4.70	4.00	3.50	3.40	3.45	3.40	3.40	3.30
20	3.33	3.60	4.30	4.60	4.15	3.50	3.40	3.40	3.40	3.40	3.30
21	3.32	3.40	4.10	4.55	4.00	3.50	3.45	3.55	3.40	3.40	3.30
22	3.33	3.60	4.00	4.50	3.95	3.50	3.40	3.40	3.40	3.40	3.30
23	3.33	3.40	4.00	4.50	3.95	3.55	3.40	3.25	3.40	3.40	3.30
24	3.45	3.60	3.90	4.60	4.00	3.50	3.45	3.40	3.40	3.40	3.30
25	3.42	3.60	3.90	(a)	3.95	3.50	3.45	3.40	3.40	3.40	3.30
26	3.60	3.50	4.00	.....	3.95	3.50	3.45	3.40	3.35	3.40	3.30
27	3.53	3.40	4.00	.....	3.85	3.50	[c]3.55	3.40	3.35	3.40	3.40
28	3.63	3.50	4.10	.....	3.85	3.55	3.50	3.45	3.35	3.40	3.40
29	3.60	3.60	4.00	.....	3.75	3.60	3.50	3.40	3.35	3.40	3.60
30	.....	3.60	4.20	.....	3.74	3.55	3.50	3.40	3.35	3.40	3.35
31	.....	3.60	.....	.....	.....	3.55	3.50	.....	3.35	.....	3.30

[a] Gage washed out.
[b] Gage replaced.
[c] Flood of four hours' duration this day; average gage height 8 feet; maximum gage height 9.50.

Rating table for Price River near Helper, Utah, from February 20 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	5	3.60	63	4.00	172	4.60	346
3.25	9	3.65	74	4.05	186	4.70	375
3.30	14	3.70	87	4.10	201	4.80	404
3.35	20	3.75	100	4.15	215	4.90	433
3.40	27	3.80	114	4.20	230	5.00	462
3.45	35	3.85	128	4.30	259	6.00	752
3.50	44	3.90	143	4.40	288	7.00	1,042
3.55	53	3.95	157	4.50	317	8.00	1,332

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is well defined between gage heights 3.20 feet and 3.70 feet. The table has been extended above gage height 4.30 feet. Above gage height 3.90 feet the rating curve is a tangent determined by one measurement at 4.30 gage height, the difference being 29 per tenth.

Estimated monthly discharge of Price River near Helper, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February 20–29	70	16	38.0	754
March	70	27	44	2,705
April	288	63	162	9,640
May 1–24	433	230	335	15,950
June 11–30	259	97	183	7,259
July	100	44	57.6	3,542
August	63	27	38.7	2,380
September	63	9	38.1	2,267
October	63	20	29.5	1,814
November	35	14	21.2	1,262
December	63	9	17.8	1,094
The period				48,670

GRAND RIVER (NORTH FORK) NEAR GRAND LAKE, COLO.

This station was established July 29, 1904, by M. C. Hinderlider. It is located at the highway bridge on the road between Grand Lake and Hot Sulphur Springs, and about 3 miles south of Grand Lake postoffice, Colo. The nearest railroad is the Colorado and Southern at Georgetown, Colo., distant by road 70 miles. A plain staff gage, grad-

uated to feet and tenths, is attached vertically to the downstream edge of the right abutment. The gage reads from 2 to 10.3 feet, the 2-foot mark resting on the bed of the stream. The gage is read twice each day by Robert C. Graves. Discharge measurements are made at higher stages from the downstream side of the single-span bridge, to which the gage is attached, sounding points being marked and numbered every 2 feet from zero to 40 feet on the downstream side of the bridge. At low water measurements are made by wading at convenient points. The initial point for soundings is a 10-penny nail driven into the bridge floor over the north face of the right abutment, and marked "0" with black paint. The channel is straight for about 500 feet above and for 150 feet below the station. The channel is very rough and has a great fall, being a typical mountain stream. Both banks are about 2 feet high, covered with a heavy sod, willows, and scattering pine trees. They do not overflow except at exceedingly high stages, and then only along the edges. The bed of the stream is rough, being composed of large and small cobblestones and scattering large bowlders. The great velocity of the current during high water and the presence of large bowlders, which break the evenness of the channel, may affect the accuracy of measurements. The bed of the channel is smoother at the station than either above or below. This is the only point available for measurements, and is probably the best that could be had. Bench mark No. 1 is a 10-penny nail driven into a notch cut in the northeast root of a 12-inch pine tree, which stands at the right end of the bridge on the downstream side. Its elevation is 8.36 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Mean daily gage height, in feet, of Grand River (North Fork) near Grand Lake, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	.....	4.25	4.10	3.60	17	.....	3.90	3.60	3.55
2	.....	4.00	4.32	3.60	18	.....	3.98	3.68	3.55
3	.....	4.00	3.98	3.60	19	.....	3.95	3.60	3.52
4	.....	3.92	3.90	3.58	20	.....	3.90	3.60	3.52
5	.....	3.90	3.80	3.55	21	.....	4.10	3.60	3.50
6	.....	3.90	3.80	3.55	22	.....	3.98	3.60	3.58
7	.....	3.85	3.75	3.55	23	.....	3.92	3.68	3.60
8	.....	3.80	3.70	3.58	24	.....	3.80	3.62	3.58
9	.....	3.80	3.70	3.62	25	.....	3.80	3.60	3.52
10	.....	3.80	3.70	3.70	26	.....	3.80	3.68	3.50
11	.....	3.80	3.70	3.62	27	.....	3.85	3.62	3.50
12	.....	3.85	3.65	3.60	28	.....	4.05	3.60	3.50
13	.....	3.80	3.60	3.60	29	4.20	3.92	3.60	3.50
14	.....	3.82	3.60	3.60	30	4.15	3.88	3.60	3.50
15	.....	3.80	3.60	3.60	31	4.30	3.80	.....	3.48
16	.....	3.85	3.60	3.55					

Discharge measurements of Grand River (North Fork) near Grand Lake, Colo., in 190

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
July 29	W. A. Lamb	40	89	2.00	4.12	17
August 15	do	39	64	1.11	3.81	7.
September 1	do	39	82	1.51	4.12	12
October 5	do	39	54	.72	3.55	3

Rating table for Grand River (North Fork) near Grand Lake, Colo., from July 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
3.45	30	3.70	59	3.95	96	4.15	133
3.50	35	3.75	66	4.00	104	4.20	144
3.55	41	3.80	73	4.05	113	4.25	156
3.60	47	3.85	80	4.10	123	4.30	170
3.65	53	3.90	88				

The above table is applicable only for open-channel conditions. It is based upon 3 discharge measurements made during 1904.

Estimated monthly discharge of Grand River (North Fork) near Grand Lake, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
August	156	73	88.2	5,42
September	176	47	62.1	3,69
October	59	33	42.3	2,60

GRAND LAKE OUTLET NEAR GRAND LAKE, COLO.

This station was established July 31, 1904, by M. C. Hinderlider. It is located at the footbridge at the lower end of Grand Lake and about one-half mile south of Grand Lake post-office, Colo. The nearest railroad is the Colorado and Southern at Georgetown, Colo., distant by road about 70 miles. A plain staff gage, graduated to feet and tenths, is attached vertically to the southeast corner of the second pier from the north end of the bridge, the 2-foot mark resting on the

bed of the stream. It is read twice each day by J. W. Davies. Discharge measurements are made during ordinary stages by wading at a ford about one-fourth mile below the gage. At high stages measurements will be made by means of a boat and cable, which will be installed in the spring of 1905. The channel is straight for about 300 feet above and for 150 feet below the station, and the current is swift. Both banks at the measuring point are about 3 feet high, steep, and the level tops are covered with spruce trees. The left bank at the gage is low, flat, and clean for a short distance back from the water's edge, after which it rises above the high-water line. Both banks are subject to overflow. The bed of the stream at the outlet is composed of coarse gravel and large bowlders, and the current is badly broken. At the point where discharge measurements are made the bed is composed of gravel and cobblestones and is uniform, clean, and permanent. The swiftness of the current at high stages may affect the accuracy of the measurements. At ordinary stages excellent results may be secured. Bench mark No. 1 is a cross made with black paint on the top of a large granite bowlder, 85 feet south of the left bank of the outlet and 40 feet west from the lake. It is marked with black paint "U. S. G. S. B. M." Its elevation is 12.05 feet above the zero of the gage. Bench mark No. 2 is a cross cut into the top of a granite bowlder at station 1,198 feet from the initial point for soundings and marked "B. M." Its elevation is 14.93 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Grand Lake outlet near Grand Lake, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft per sec.*	*Feet.*	*Sec.-feet.*
July 30	W. A. Lamb	150	184	0.95	2.40	174
August 15	do	50	53	1.62	2.08	86
September 1	do	51	63	2.08	2.23	131
October 5 [a]	do	43	36	1.22	1.78	44

[a] By wading.

Mean daily gage height, in feet, of Grand Lake outlet near Grand Lake, Colo., for 19

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.30	2.23	1.78	1.55	17	.....	2.04	1.74	1.70	1.
2	.....	2.26	2.40	1.80	1.54	18	.....	2.16	1.74	1.70	1.
3	.....	2.24	2.34	1.80	.....	19	.....	2.28	1.74	1.68	1.
4	.....	2.19	2.24	1.78	.....	20	.....	2.27	1.73	1.69	1.
5	.....	2.16	2.15	1.78	.....	21	.....	2.30	1.73	1.68	1.
6	.....	2.13	2.08	1.76	.....	22	.....	2.30	1.72	1.68	1.
7	.....	2.09	2.02	1.74	.....	23	.....	2.21	1.72	1.68	1.
8	.....	2.06	1.97	1.74	.....	24	.....	2.14	1.73	1.66	1.
9	.....	2.04	1.93	1.75	.....	25	.....	2.10	1.72	1.66	1.
10	.....	2.02	1.89	1.80	1.44	26	.....	2.07	1.70	1.64	1.
11	.....	2.01	1.86	1.78	1.42	27	.....	2.04	1.72	1.64	.....
12	.....	2.01	1.86	1.78	1.40	28	.....	2.10	1.72	1.62	.....
13	.....	2.02	1.84	1.78	1.38	29	.....	2.14	1.71	1.62	.....
14	.....	2.04	1.82	1.74	1.36	30	.....	2.40	2.14	1.72	1.60	.....
15	.....	2.04	1.78	1.74	1.36	31	.....	2.38	2.11	.....	1.57	.....
16	.....	2.04	1.76	1.72	1.34							

Rating table for Grand Lake outlet near Grand Lake, Colo., from July 30 to Decem-
31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-fee*
1.55	21	1.80	47	2.05	91	2.25	136
1.60	25	1.85	54	2.10	102	2.30	148
1.65	29	1.90	62	2.15	113	2.35	160
1.70	34	1.95	71	2.20	124	2.40	173
1.75	40	2.00	81				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is fairly well defined between gage heights 1.80 feet and 2.40 feet. The table has been extended below gage height 1.80 feet.

Estimated monthly discharge of Grand Lake outlet near Grand Lake, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
August	148	83	109	6,70
September	173	34	63.7	3,79
October	47	23	36.3	2,23

GRAND RIVER AT HOT SULPHUR SPRINGS, COLO.

This station was established July 27, 1904, by M. C. Hinderlider. It is located at the highway bridge about one-eighth mile below Hot Sulphur Springs, Colo., and 5 miles above the mouth of Williams Fork. A plain staff gage, graduated to feet and tenths, is bolted vertically to the downstream edge of the first pier from the right bank. The gage reads from 2 to 10.8 feet, the 2-foot mark resting on bed rock. It is read twice each day by E. E. Von Gohern. Discharge measurements, except at very low stages, are made from the upstream side of the three-span bridge to which the gage is attached. The initial point for soundings is located over the inner face of the right abutment, and is marked "0" on the upstream hub rail. Sounding points are marked on this rail every 2 feet to 124 feet. The channel above the station is curved at almost right angles. The current is swift, the water passing under the bridge squarely. The channel below the station is straight for about 200 feet, and the current is swift at high, and medium at low stages. Both banks are high, and can not overflow. The bed of the stream consists of bed rock, heavy gravel, and large bowlders on the right side. On the left, the channel is composed of a sloping gravel bar, extending outward to the left abutment. The channel is free from vegetation and permanent. There is but one channel, at all stages, broken by two piers. The accuracy of measurements will probably be affected by the boiling condition of the water alongside the right pier, and by the large bowlders in the channel beneath the bridge. Bench mark No. 1 is a United States Geological Survey standard bench-mark tablet set in cement in the south face of the sandstone cliff, near the north end of the bridge and about 2 feet above the roadway. Its elevation, painted on the tablet, is 18.99 feet above the zero of the gage. Bench mark No. 2 is a cross painted on the north pier above the gage rod. Its elevation is 16.48 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Grand River at Hot Sulphur Springs, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 26	W. A. Lamb	104	300	3.78	4.36	1,134
August 14	do	85	282	2.28	3.65	643
August 31	do	87	273	2.23	3.60	608
October 6	do	64	187	1.62	3.00	303

Mean daily gage height, in feet, of Grand River at Hot Sulphur Springs, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.05	4.05	3.10	2.80	2.72
2	.....	3.90	4.22	3.08	2.70	2.75
3	.....	3.85	3.98	3.12	2.70	2.8
4	.....	3.80	3.82	3.10	2.70	2.80
5	.....	3.80	3.62	3.02	2.60	2.80
6	.....	3.65	3.52	3.05	2.60	2.82
7	.....	3.60	3.52	3.02	2.60	2.85
8	.....	3.60	3.50	3.05	2.60	2.8
9	.....	3.50	3.45	3.02	2.60	2.85
10	.....	3.50	3.40	3.10	2.60	2.85
11	.....	3.40	3.30	3.08	2.60	2.85
12	.....	3.50	3.25	3.08	2.60	2.85
13	.....	3.65	3.25	3.10	2.60	2.85
14	.....	3.65	3.25	3.05	2.60	2.85
15	.....	3.70	3.00	3.05	2.60	2.85
16	.....	3.70	3.15	3.10	2.60	2.85
17	.....	3.75	3.15	3.10	2.70	2.85
18	.....	3.75	3.25	3.10	2.70	2.85
19	.....	4.10	3.22	2.98	2.70	2.85
20	.....	3.90	3.22	3.00	2.40	2.85
21	.....	3.95	3.20	2.95	2.40	2.8
22	.....	3.95	3.20	2.95	2.40	2.8
23	.....	3.80	3.20	2.95	2.78	2.85
24	.....	3.60	3.22	3.00	2.75	2.8
25	.....	3.60	3.08	3.00	2.70	.....
26	.....	3.65	3.02	2.90	2.75	.....
27	.....	3.65	3.10	3.00	2.75	.....
28	4.20	3.78	3.15	2.90	2.75	.....
29	4.15	3.70	3.10	2.80	2.70	.....
30	4.15	3.70	3.12	2.80	2.70	.....
31	4.10	3.60	.....	2.80	.....	.....

Rating table for Grand River at Hot Sulphur Springs, Colo., from July 27 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	245	3.05	333	3.40	501	3.90	790
2.85	260	3.10	355	3.50	554	4.00	860
2.90	276	3.15	378	3.60	609	4.10	930
2.95	294	3.20	402	3.70	666	4.20	1,010
3.00	313	3.30	450	3.80	725	4.30	1,090

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904, and is well defined.

Estimated monthly discharge of Grand River at Hot Sulphur Springs, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 28–31	1,010	930	970	7,696
August	995	501	685	42,120
September	1,026	313	491	29,220
October	364	245	320	19,680
November	245	125	198	11,780
December 1–24	245	71	132	6,283

GRAND RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904, by M. C. Hinderlider. It is located at the mouth or upper end of the Gore Canyon, about 3 miles south of Kremmling, Colo. A standard wire gage is attached to the cantilever arm of the frame to which the gage rod is spiked in a horizontal position. The gage rod is a 2 by 4 inch timber, 13 feet long, painted white, and graduated to feet and tenths, from 2 feet to 13 feet. The length of the wire from the end of the weight to the marker is 27.64 feet. The gage is read twice each day by J. C. Harper. Discharge measurements are made from a three-fourths inch wire cable stretched across the river just below the gage and about 150 feet above the wagon bridge. The cable is approximately 280 feet long and is tagged with tin tags, which are marked, every 5 feet from the top of the right bank, which is a high sandstone cliff, to the top of the left bank. The initial point for soundings is the face of the rock to which the cable is anchored on the right bank. The channel is straight for about 100 feet above and for 150 feet below the station. The current is very sluggish at low water and medium to swift at high water, but it is the only location available below the mouth of Blue River. The right bank is the old grade of the Denver and Northwestern Railroad, and is not subject to overflow. The left bank is abrupt, covered with bushes and large bowlders, and does not overflow. The bed of the stream is composed of sand and silt and scattering bowlders, clean of vegetation and reasonably permanent. The bench mark is a cross cut in the east face of a large bowlder on the right bank about 20 feet south of the cable, marked with black paint "U. S. B. M." Its elevation is 24.93 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Grand River near Kremmling, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis-charge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 24	W. A. Lamb	122	1,269	1.44	5.87	1,82
August 11	do	108	922	1.05	3.50	9
August 26	do	113	987	1.22	4.04	1,2
August 29	do	113	1,061	1.35	4.70	1,4
October 9	do	105	387	1.74	2.40	67

Mean daily gage height, in feet, of Grand River near Kremmling, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1		4.78	4.35	2.85	1.70	17		4.30	3.10	2.15	1.
2		4.58	5.80	2.68	1.62	18		5.15	2.88	2.22	1.
3		4.45	5.15	2.52	1.60	19		5.75	2.85	2.05	1.
4		4.28	4.40	2.45	1.80	20		5.08	2.68	2.10	1.
5		4.30	4.08	2.30	1.60	21		4.62	2.62	2.18	1.
6		4.25	3.72	a 2.30	1.40	22		5.12	2.65	2.25	1.
7		3.85	3.55	2.38	1.82	23		4.22	2.65	2.25	1.
8		3.80	3.28	2.42	1.45	24	6.00	4.08	2.68	2.20	1.
9		3.70	3.10	2.48	1.38	25	6.35	3.85	2.58	2.20	1.
10		3.55	3.00	2.58	1.25	26	5.92	4.00	2.58	1.85	1.
11		3.52	2.88	2.52	0.70	27	5.72	4.22	2.70	1.92	..
12		3.70	2.75	2.42	0.80	28	5.32	4.68	2.65	1.92	....
13		4.02	2.55	2.42	1.02	29	5.38	4.55	2.50	1.98	....
14		4.32	2.42	2.38	1.20	30	5.45	4.30	2.55	1.82	....
15		4.40	2.35	2.28	1.42	31	5.15	4.15		1.70	....
16		4.28	2.55	2.20	1.32						

a Gage datum lowered 3 feet October 6. All gage heights refer to original datum.

Rating table for Grand River near Kremmling, Colo., from July 24 to December 31, 1

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
2.00	590	3.20	905	4.30	1,290	5.40	1,675
2.10	610	3.30	940	4.40	1,325	5.50	1,710
2.20	630	3.40	975	4.50	1,360	5.60	1,745
2.30	650	3.50	1,010	4.60	1,395	5.70	1,780
2.40	675	3.60	1,045	4.70	1,430	5.80	1,815
2.50	700	3.70	1,080	4.80	1,465	5.90	1,850
2.60	725	3.80	1,115	4.90	1,500	6.00	1,885
2.70	750	3.90	1,150	5.00	1,535	6.10	1,920
2.80	775	4.00	1,185	5.10	1,570	6.20	1,955
2.90	805	4.10	1,220	5.20	1,605	6.30	1,990
3.00	835	4.20	1,255	5.30	1,640	6.40	2,025
3.10	870						

The above table is applicable only for open-channel conditions. It is based up 5 discharge measurements made during 1904 and is fairly well defined. Above gage height 3.00 feet the rating curve is a tangent, the difference being 35 per tenth.

Estimated monthly discharge of Grand River near Kremmling, Colo., for 1904.

[Drainage area, 2,380 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
July 24–31	2,008	1,588	1,765	28,220	0.742	0.222
August	1,798	1,010	1,308	80,430	.550	.634
September	1,815	662	893	53,140	.375	.420
October	790	530	646	39,720	.271	.312
November 1–26	554	397	470	24,240	.197	.191

GRAND RIVER AT GLENWOOD SPRINGS, COLO.

This station was first located May 12, 1899, at the request of the Denver and Rio Grande Railway Company, at the railroad bridge, a quarter of a mile west of the depot and just above the mouth of Roaring Fork. A wire gage was used. At the beginning of 1900, however, a new gage rod was located near the electric-light works. This gage consisted of a light vertical staff, to the lower end of which was attached a wooden float which rested on the surface of the water, standing in a well or box made of 6-inch boards. The bottom of this well connected with a small wooden flume extending out into the river, which allowed the water in the well to assume the level of the river surface. The vertical staff attached to the float was graduated to feet and tenths. In July, 1902, this gage, being in bad repair, was replaced with an automatic water register, the site being the same as that of the old float gage. This register never worked satisfactorily, and was later replaced with a float gage, using the same well and intake flume as was previously used. The present gage consists of a metal float and counterweight connected with a pliable wire passing over pulleys, so arranged that a rise of 1 foot in the river registers but one-half the amount on the rod. By this arrangement the large rise and fall of the river is readily accommodated by the length of gage, which would be impossible with a direct-reading gage. The gage rod proper consists of a light pine rod 1 by 1 inch by 5 feet long, securely fastened to the small house in which the apparatus is located. A pointer attached to a counterweight slides along the gage rod and registers the rise and fall of the river. This gage has given entire satisfaction. The gage and equipment are inclosed within a small house, which is kept locked. The observer, who is the engineer of the electric-light works, is located immediately across the street from the gage. Readings are taken in the morning and evening during the entire year. Measurements are made from the single-span steel wagon bridge crossing the river between the town and the hotel. The channel is good, being com-

posed of gravel and rock, and does not change much; the banks are high and not subject to overflow. The current is moderate to swift.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Grand River at Glenwood Springs, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
April 4	R. I. Meeker	189	512	1.61	3.55	82
April 25	do	195	903	3.40	5.20	3,0
May 23	do	203	1,478	7.81	8.30	11,54
May 26	do	206	1,541	12.00	9.10	18,50
June 27	do	203	1,274	6.94	7.42	8,84
August 6	do	192	752	2.80	4.79	2,10
August 8	G. B. Monk	189	727	2.82	4.60	2,04
September 5	R. I. Meeker	189	809	3.11	5.05	2,51

Mean daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 190

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05	3.02	3.68	3.55	5.80	8.45	7.38	5.12	5.00	4.20	3.98	
2	3.08	3.05	3.68	3.55	5.72	8.13	7.28	5.02	5.40	4.30	3.90	
3	3.12	3.12	3.52	3.52	5.72	8.00	7.05	4.98	5.42	4.28	3.88	
4	3.18	3.10	3.55	3.58	5.68	7.70	6.85	4.88	5.20	4.22	3.88	
5	3.20	3.12	3.60	3.65	5.58	7.33	6.72	4.82	5.05	4.22	3.88	
6	3.12	3.20	3.60	3.65	5.42	7.03	6.65	4.80	4.85	4.20	3.85	
7	3.48	3.10	3.65	3.62	5.42	7.10	6.48	4.70	4.75	4.15	3.78	
8	3.50	3.12	3.78	3.68	5.88	7.57	6.50	4.60	4.65	4.20	3.78	
9	3.05	3.08	3.80	3.62	5.75	7.67	6.48	4.60	4.60	4.20	3.80	
10	3.05	2.95	3.78	3.55	5.65	7.80	6.40	4.58	4.52	4.20	3.78	
11	3.10	3.05	3.80	3.60	5.78	8.23	6.38	4.52	4.48	4.25	3.50	
12	3.12	3.12	3.82	3.92	6.08	8.25	6.35	4.52	4.42	4.25	3.32	
13	3.12	3.18	3.72	4.52	6.40	8.55	6.25	4.58	4.32	4.22	3.38	
14	3.12	3.18	3.72	5.00	6.68	8.67	6.18	4.68	4.20	4.22	3.45	
15	3.15	3.22	3.78	5.28	6.82	8.65	6.08	4.78	4.20	4.20	3.55	
16	3.12	3.22	3.70	5.48	6.80	8.52	5.92	4.82	4.20	4.12	3.65	
17	3.15	3.25	3.65	5.52	6.70	8.52	5.85	4.82	4.20	4.08	3.70	
18	3.22	3.25	3.60	5.55	6.70	8.50	5.80	4.90	4.35	4.10	3.70	
19	3.20	3.18	3.70	5.70	7.05	8.38	5.70	5.30	4.32	4.08	3.78	
20	3.15	3.18	4.00	5.85	7.60	8.45	5.60	5.42	4.32	4.02	3.70	
21	3.08	3.20	4.05	5.90	7.98	8.50	5.48	5.15	4.25	3.98	3.55	
22	3.05	3.15	3.98	5.95	8.15	8.28	5.48	5.10	4.20	4.02	3.55	
23	3.02	3.22	3.80	5.48	8.32	8.12	5.45	5.18	4.28	4.05	3.48	
24	3.08	3.38	3.72	5.32	9.05	7.92	5.45	4.95	4.28	4.10	3.40	
25	3.08	3.55	3.68	5.20	9.32	8.85	5.78	4.85	4.22	4.10	3.38	
26	2.98	3.52	3.52	5.10	9.10	7.70	5.48	4.78	4.20	4.10	3.35	
27	2.95	3.58	3.52	5.22	8.78	7.45	5.38	4.80	4.25	4.00	3.35	
28	3.00	3.75	3.52	5.60	8.52	7.42	5.22	4.90	4.30	4.00	3.45	
29	2.95	3.65	3.55	5.98	8.28	7.35	5.18	5.08	4.30	4.00	3.32	
30	3.02	.....	3.58	6.05	8.30	7.40	5.18	5.08	4.25	4.00	3.38	
31	3.08	.....	3.50	.....	8.70	.....	5.22	5.00	.....	3.95	.....	

Rating table for Grand River at Glenwood Springs, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	380	3.80	990	4.70	2,000	6.20	4,640
2.90	430	3.90	1,080	4.80	2,140	6.40	5,090
3.00	480	4.00	1,180	4.90	2,290	6.60	5,580
3.10	530	4.10	1,290	5.00	2,440	6.80	6,110
3.20	580	4.20	1,400	5.20	2,740	7.00	6,670
3.30	630	4.30	1,510	5.40	3,050	7.50	8,260
3.40	690	4.40	1,630	5.60	3,400	8.00	10,210
3.50	760	4.50	1,750	5.80	3,790	8.50	12,610
3.60	830	4.60	1,870	6.00	4,210	9.00	15,640
3.70	910						

The above table is applicable only for open-channel conditions. It is based upon 27 discharge measurements made during 1900 to 1904, inclusive, and is well defined. It is the same as the 1903 rating table to 8.00 feet gage height.

Estimated monthly discharge of Grand River at Glenwood Springs, Colo., for 1904.

[Drainage area, 4,523 square miles.[a]]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	760	455	539	33,140	0.119	0.137
February	950	455	605	34,800	.134	.144
March	1,235	760	911	56,020	.201	.232
April	4,315	774	2,291	136,300	.507	.566
May	18,080	3,084	7,759	477,100	1.72	1.98
June	14,640	6,757	10,510	625,400	2.32	2.59
July	7,844	2,710	4,420	271,800	.977	1.13
August	3,084	1,774	2,271	139,600	.502	.579
September	3,084	1,400	1,781	106,000	.394	.440
October	1,510	1,130	1,323	81,350	.293	.338
November	1,160	642	854	50,820	.189	.211
December	746	355	590	36,830	.132	.152
The year	18,080	355	2,822	2,049,000	.624	8.50

[a] This area has been revised since the 1903 report.

GRAND RIVER NEAR PALISADES, COLO.

This station was established April 9, 1902, by John E. Field. It is located at the iron highway bridge at the point where the river enters Grand Valley, about 2 miles above Palisades. The station is above all irrigating ditches supplying water to Grand Valley, with the exception of one pumping plant, which takes about 20 second-feet from the river one-fourth mile above the station. The gage, as originally installed, was of wire with window weight and located on downstream side near center of bridge. On April 5, 1904, the old wire gage was replaced by a new chain gage. Zero on new chain gage is identical with zero of wire gage. The scale on the inside of the box reads from 11.6 to 22.7 feet. At low water, depth of water at gage is about 12 feet. The length of chain from end of weight to center of marker is 21.27 feet. The gage is read twice daily by E. N. Purdy, who is engineer at the Mount Lincoln pumping plant above the bridge. Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is the edge of the cap stone of masonry abutment of bridge on the left bank. The channel is straight for 600 feet above and below the station. The right bank is high and rocky and will not overflow. The left bank is somewhat lower and will overflow at extreme high water. Above the banks the mountains rise rather abruptly on either side. The bed of the stream is composed of large bowlders, which are covered at low water with a deposit of mud. During high water this deposit is carried away, and at low water a new deposit forms. The bench mark is a point on cap stone of the approach abutment on the right bank of the river. A circle is cut about the point and also the letters "B. M." The elevation of bench mark is 29.49 feet above zero of gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Grand River near Palisades, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
April 6	R. I. Meeker	145	1,199	1.10	12.40	1,318
April 26	do	155	1,524	2.87	14.15	4,367
May 28	do	212	2,500	7.82	19.15	19,560
July 2	do	180	2,064	5.75	17.00	11,880
August 10	do	181	1,314	1.93	13.20	2,538
September 7	do	180	1,394	2.18	13.50	3,041

Mean daily gage height, in feet, of Grand River near Palisades, Colo., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	12.25	15.25	19.15	17.40	14.15	14.25	13.10
2	12.20	15.10	18.70	17.10	13.90	14.15	13.10
3	12.25	15.10	18.40	16.85	13.75	14.30	13.10
4	12.20	15.05	18.05	16.65	13.60	14.20	13.00
5	12.35	14.85	17.55	16.55	13.55	13.95	12.90
6	12.50	14.65	17.10	16.30	13.50	13.60	13.15
7	12.50	14.65	16.85	16.10	13.40	13.45	13.25
8	12.50	15.20	17.20	16.00	13.35	13.35	13.15
9	12.45	15.25	17.60	15.95	13.30	13.20	13.15
10	12.40	15.10	17.75	15.85	13.20	13.15	13.20
11	12.40	15.20	17.95	15.85	13.10	13.00	13.10
12	12.55	15.70	18.45	15.85	13.10	13.05	13.10
13	13.00	16.30	19.00	15.75	13.20	12.95	13.10
14	13.75	16.75	19.10	15.60	13.30	12.90	13.00
15	14.10	16.80	19.10	15.45	13.40	12.80	13.00
16	14.35	16.95	18.95	15.30	13.45	12.70	12.95
17	14.65	16.85	18.85	15.20	13.40	12.80	12.90
18	14.65	16.85	18.90	15.05	13.70	12.80	12.80
19	15.05	17.30	18.90	14.90	13.75	12.90	12.85
20	15.15	17.80	18.80	14.80	14.20	12.85	12.80
21	15.30	18.10	18.95	14.55	13.95	12.80	12.80
22	15.35	18.45	18.75	14.45	13.80	12.85	12.80
23	15.00	18.70	18.50	14.45	13.75	13.05	12.80
24	14.55	19.60	18.25	14.35	13.75	13.10	12.80
25	14.35	20.00	18.15	14.35	13.55	13.00	12.80
26	14.20	19.75	17.90	14.35	13.40	13.15	12.80
27	14.25	19.40	17.50	14.35	13.50	13.10	12.70
28	14.75	19.15	17.45	14.25	13.95	13.15	12.70
29	15.30	18.90	17.45	14.10	13.85	13.10	12.60
30	15.50	18.90	17.50	14.15	13.90	13.15	12.60
31	.....	19.15	.....	14.30	13.75	.....	12.60

Rating table for Grand River near Palisades, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
12.20	1,320	13.30	2,710	14.40	4,920	16.40	10,120
12.30	1,400	13.40	2,870	14.60	5,400	16.60	10,680
12.40	1,500	13.50	3,040	14.80	5,880	16.80	11,270
12.50	1,600	13.60	3,220	15.00	6,360	17.00	11,870
12.60	1,710	13.70	3,400	15.20	6,860	17.50	13,520
12.70	1,830	13.80	3,600	15.40	7,380	18.00	15,460
12.80	1,950	13.90	3,800	15.60	7,900	18.50	17,540
12.90	2,090	14.00	4,020	15.80	8,440	19.00	19,720
13.00	2,230	14.10	4,240	16.00	9,000	19.50	22,100
13.10	2,390	14.20	4,460	16.20	9,560	20.00	24,800
13.20	2,550	14.30	4,680				

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902, 1903, and 1904. It is well defined between gage heights 13.00 and 17.00 feet. Measurements between gage heights 12.00 and 13.00 feet are scattered and uncertain. The table has been extended above 17.00 feet gage height.

Estimated monthly discharge of Grand River near Palisades, Colo., for 1904.

[Drainage area, 8,546 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	7,640	1,320	3,906	232,400	0.457	0.5[illegible]
May	24,800	5,520	12,800	787,000	1.50	1.7[illegible]
June	20,400	11,420	16,480	980,600	1.93	2.1[illegible]
July	13,170	4,240	7,400	455,000	.866	.9[illegible]
August	4,460	2,390	3,242	199,300	.379	.4[illegible]
September	4,680	1,830	2,654	157,900	.311	.3[illegible]
October	2,630	1,710	2,141	131,600	.251	.2[illegible]
The period				2,944,000		

FRASER RIVER NEAR COULTER, COLO.

This station was established July 28, 1904, by M. C. Hinderlider. It is located at the wagon bridge on the main road between Coulter and Grand Lake, Colo., and about 3 miles above the mouth of Fraser River. A plain staff gage, graduated to feet and tenths, is spiked vertically to the downstream inner edge of the first pier from the left bank. The gage reads from 2 to 10.8 feet, the 2-foot mark resting on the bed of the stream. It is read twice each day by J. N. Ostrander. Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached, and which is numbered on the hand rail every 2 feet from zero to 81 feet. The initial point for soundings is immediately over the inner face of the left abutment and marked "zero" on the downstream hand rail. The channel is straight for about 100 feet above, and curved for about 100 feet below the station. The current is medium above and swift below the measuring section. The right bank is about 2 feet high, covered with willows, and overflows at very high stages. The left bank above the station is a high abrupt mesa. Below the station is a 6-foot mesa for about 50 feet, then a low, brush-covered flat which is overflowed at high stages. The bed of the stream is composed of smooth cobblestones, and the cross section is fairly uniform, clean, and permanent. There is one channel at all stages, broken by two crib piers. A small and temporary dam a portion of the way across the stream, 30 feet below the bridge, may affect the gage readings at times if changed. Bench mark No. 1 is a nail in the top of a white pine stake driven into the left bank about 30 feet southeast of the left end of the bridge, projecting

about 6 inches above the surface of the ground, and marked "U. S. G. S. B. M." Its elevation is 13.12 feet above the zero of the gage. Bench mark No. 2 was established October 6, 1904. It is a cross cut on the top of the foundation stone at the southeast corner of the residence of the observer. The stone is marked "U. S. B. M." on the east face. The elevation of the bench mark is 13.09 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Fraser River near Coulter, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 28	W. A. Lamb	73	129	2.22	5.04	286
August 14	do	72	107	1.61	4.88	172
August 31	do	70	108	1.53	4.85	165
October 6	do	69	90	1.11	4.63	100

Mean daily gage height, in feet, of Fraser River near Coulter, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		4.95	5.25	4.65	17		4.82	4.82	4.58
2		4.90	5.20	4.60	18		5.20	4.75	4.55
3		4.90	5.00	4.60	19		4.98	4.70	[a]4.50
4		4.90	4.92	4.65	20		4.90	4.70	4.50
5		4.85	4.88	4.65	21		4.92	4.75	4.60
6		4.85	4.85	4.65	22		4.92	4.70	4.60
7		4.80	4.80	4.60	23		4.88	4.70	4.60
8		4.82	4.80	4.60	24		4.80	4.70	4.62
9		4.85	4.75	4.60	25		4.75	4.70	4.55
10		4.80	4.75	4.60	26		4.85	4.70	4.50
11		4.75	4.75	4.60	27		4.85	4.65	4.45
12		4.80	4.70	4.65	28	5.00	4.92	4.60	4.35
13		4.95	4.70	4.65	29	5.02	4.80	4.70	4.35
14		4.88	4.70	4.60	30	5.05	4.82	4.65	4.35
15		4.78	4.65	4.60	31	4.95	4.82		4.35
16		4.85	4.90	4.60					

[a] Ice conditions, October 19 to end of year.

Rating table for Fraser River near Coulter, Colo., from July 28 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.35	52	4.60	91	4.85	165	5.10	340
4.40	59	4.65	102	4.90	188	5.15	400
4.45	66	4.70	114	4.95	215	5.20	470
4.50	73	4.75	128	5.00	248	5.25	550
4.55	81	4.80	145	5.05	290		

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is well defined between gage heights 4.65 feet and 5.05 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Fraser River near Coulter, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 28–31	290	215	254	2,015
August	470	128	181	11,130
September	550	91	158	9,405
October [a]	102	52	84.9	5,220

[a] October 19–31 rating table applied as for open channel.

WILLIAMS FORK NEAR HOT SULPHUR SPRINGS, COLO.

This station was established July 25, 1904, by M. C. Hinderlider. It is located at a wagon bridge on the ranch of F. A. Field, about 9 miles west of Hot Sulphur Springs, Colo., and about the same distance above the mouth of the river. A plain staff gage, graduated to feet and tenths from 2 feet, which is on the bed of the stream, to 8 feet, is fastened vertically to the downstream end of the middle crib pier. It is read twice each day by F. A. Field. Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is a 60-penny nail driven into the top of the left end of the downstream guard rail of the bridge, immediately over the inside face of the abutment. Sounding points are marked every 2 feet by nails on the downstream guard rail. The channel is straight for about 100 feet above and below the station. The current is very swift and somewhat rough above, and swift and fairly smooth below the section. The right bank is a low gravel bar, lined with willows, and overflows at very high stages. The left bank is level pasture lands, about 4 feet high, and is not liable to overflow. The bed of the stream is composed of small and medium sized bowlders, and is permanent. The middle pier may

slightly affect the measurements at high stages. The bench mark is a 60-penny nail driven into the south face of a small white pine tree standing on the left bank of the river, 30 feet north of the west end of the bridge. Its elevation is 6.03 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Williams Fork near Hot Sulphur Springs, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 25	W. A. Lamb	54	78	3.41	3.95	266
August 13	do	50	70	2.13	3.69	149
August 30	do	50	66	2.09	3.66	138
October 7	do	48	58	1.69	3.45	98

Mean daily gage height, in feet, of Williams Fork near Hot Sulphur Springs, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	.....	3.77	3.70	3.45	17	.....	3.56	3.52	3.35
2	.....	3.74	3.66	3.41	18	.....	3.65	3.50	3.30
3	.....	3.71	3.62	3.40	19	.....	3.62	3.51	3.28
4	.....	3.70	3.56	3.39	20	.....	3.56	3.48	3.36
5	.....	3.69	3.55	3.39	21	.....	3.60	3.50	3.36
6	.....	3.67	3.54	3.38	22	.....	3.56	3.50	3.38
7	.....	3.64	3.54	3.40	23	.....	3.56	3.50	3.32
8	.....	3.69	3.54	3.40	24	.....	3.54	3.50	3.32
9	.....	3.66	3.52	3.41	25	3.95	3.54	3.48	3.24
10	.....	3.54	2.50	3.40	26	3.90	3.59	3.48	3.26
11	.....	3.55	3.50	3.39	27	3.88	3.56	3.47	3.25
12	.....	3.58	3.49	3.40	28	3.86	3.60	3.43	3.28
13	.....	3.57	3.48	3.40	29	3.87	3.55	3.42	3.38
14	.....	3.56	3.48	3.36	30	3.85	3.56	3.44	3.32
15	.....	3.56	3.46	3.40	31	3.80	3.54	.....	3.25
16	.....	3.56	3.44	3.38					

Rating table for Williams Fork near Hot Sulphur Springs, Colo., from July 25 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.25	70	3.45	98	3.65	137	3.85	206
3.30	76	3.50	107	3.70	150	3.90	234
3.35	83	3.55	116	3.75	165	3.95	266
3.40	90	3.60	126	3.80	183		

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is well defined between gage heights 3.45 feet and 3.95 feet. The table has been extended below gage height 3.45 feet.

Estimated monthly discharge of Williams Fork near Hot Sulphur Springs, Colo., for 190

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 25–31	266	183	220	3,05
August	172	114	129	7,9
September	150	93	109	6,4
October	98	69	84	5,16

TROUBLESOME RIVER AT TROUBLESOME, COLO.

This station was established July 22, 1904, by M. C. Hinderlider. It is located about 100 yards below the highway bridge at Troublesome, Colo. The gage is an inclined plain staff, graduated to feet and tenths, vertically from 0.8 to 5.8 feet, securely fastened to stakes driven into the left bank and bed of the stream. One vertical foot equals 1.525 feet on the slope. The gage is read twice each day by Mrs. Eva Becker. Discharge measurements are made at almost all stages of flow by wading at or near the gage. At exceedingly high stages they may be made from the two-span bridge about 100 yards above the gage rod. The initial point for soundings is the west face of the stake driven into the top of the left bank, and to which the gage rod is fastened. The channel is straight for about 50 feet above and for 1[illegible] feet below the station. The current is of moderate velocity and uniform. The right bank is about 3 feet high, lined with a heavy growth of willows, and is not subject to overflow. The left bank is precipitous, about 4 feet high, and is a level meadow which does not overflow. The bed of the stream is composed of small cobblestones and gravel, and is clean, uniform, and stable. There is but one channel at all stages, the depths varying from 1 to 4 feet. There are no adverse conditions except at extremely high stages, when measurements must be made from the highway bridge, which is a poor place owing to poor cross section, bridge abutments, and temporary dam a few feet above. Bench mark No. 1 is a 10-penny nail driven into the top of the stake on the left bank, to which the gage rod is fastened. Its elevation is 5.83 feet above the zero of the gage. Bench mark No. 2 is the center of a cross painted with black paint on the bottom log near the southeast corner of the observer's house, and marked "U. S. B. M." Its elevation is 16.08 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Troublesome River at Troublesome, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 22	Hinderlider and Lamb	27	23	0.91	2.01	21
August 13	W. A. Lamb	24	21	.76	1.93	16
August 30	do	28	24	1.12	2.07	27
October 7	do	26	25	1.08	2.02	27

Mean daily gage height, in feet, of Troublesome River at Troublesome, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	.....	a 1.95	2.20	2.00	17	.....	2.00	1.95	2.00
2	.....	a 1.95	2.20	2.00	18	.....	2.10	1.95	2.00
3	.....	a 1.90	2.10	2.00	19	.....	2.10	2.00	1.98
4	.....	a 1.90	2.05	2.02	20	.....	2.50	2.00	1.95
5	.....	a 1.90	2.00	2.00	21	.....	2.10	2.00	2.00
6	.....	a 1.90	2.00	2.00	22	.....	2.10	2.00	2.00
7	.....	1.90	2.00	2.00	23	2.00	2.00	2.00	2.00
8	.....	1.90	2.00	2.00	24	1.95	2.00	2.00	2.00
9	.....	1.90	2.00	2.00	25	2.05	2.05	2.00	2.00
10	.....	1.90	2.00	2.10	26	1.98	2.10	2.00	1.95
11	.....	1.90	2.00	2.05	27	1.92	2.10	2.00	1.95
12	.....	2.00	a 2.00	2.00	28	1.95	2.25	2.00	1.95
13	.....	1.90	2.00	2.00	29	2.10	2.15	2.00	1.95
14	.....	1.90	2.00	2.00	30	2.00	2.10	2.00	1.90
15	.....	2.00	1.95	2.00	31	a 2.00	2.00	.....	1.95
16	.....	2.00	1.95	2.00					

a Estimated.

Rating table for Troublesome River at Troublesome, Colo., from July 22 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	14	2.10	30	2.25	48	2.40	74
1.95	17	2.15	35	2.30	55	2.45	86
2.00	21	2.20	41	2.35	64	2.50	100
2.05	25						

The above table is applicable only for open-channel conditions. It is based upon 3 discharge measurements made during 1904, between gage heights 1.93 feet and 2.07 feet, and on an extension from 2.07 to 2.50 based on logarithmic curve.

Estimated monthly discharge of Troublesome River at Troublesome, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 23–31	30	15	20.7	[illegible]
August	100	14	24.3	1,494
September	41	17	22.2	1,[illegible]
October	30	14	20.4	1,[illegible]

MUDDY RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904, by M. C. Hinderlider. It is located at the wagon bridge about one-eighth mile southwest of Kremmling, Colo., and about 2 miles above the junction of Muddy River with Grand River. A plain staff gage, graduated to feet and tenths, is attached vertically to the lower left corner of the middle crib pier of the bridge. The gage reads from 2 to 14 feet, the 2-foot mark resting on the bed of the stream. It is read twice each day by E. A. Magee. Discharge measurements are made during high water from the downstream side of the two-span highway bridge to which the gage is attached, and at ordinary and low stages by wading near the gage. The initial point for soundings is a 10-penny nail driven in the downstream hand rail over the north face of the left abutment. The hand rail is marked from 0 to 58 feet with nails driven in flush. The channel is curved for about 100 feet above and straight for 50 feet below the station. The current is sluggish. The right bank is clean and almost perpendicular. It is about 10 feet high below, and 8 feet high above the station. The left bank below the bridge slopes at an angle of about 45°, is 10 feet high, and lined with willows. Above the bridge it is irregular, about 8 feet high, and is overflowed at very high water out for 50 to 100 feet. Both banks are meadow or pasture lands. The bed of the stream is composed of mud, with some sand and a few loose rock washed from the riprap about the south abutment. It is clean, but shifting. There is one channel broken by the middle pier. The tortuous nature of the channel, unstable bed, and middle pier of the bridge are conditions which may affect the measurements. The bench mark is a 60-penny spike driven horizontally into the west face of the left end of the downstream bridge stringer, over the left abutment. Its elevation is 13.65 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Muddy River near Kremmling, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
August 13	W. A. Lamb	9	5	1.20	4.30	6
August 30	do	35	21	1.29	4.75	27
October 7	do	16	15	.80	4.33	12

Mean daily gage height, in feet, of Muddy River near Kremmling, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		4.25	4.88	4.45	17		4.30	4.30	4.45
2		4.28	4.92	4.45	18		4.50	4.45	4.42
3		4.25	4.90	4.50	19		4.50	4.52	4.48
4		4.20	4.82	4.42	20		4.50	4.50	4.55
5		4.22	4.70	4.40	21		4.65	4.42	4.52
6		4.22	4.70	4.35	22		4.50	4.38	4.42
7		4.20	4.55	4.40	23		4.50	4.40	4.40
8		4.20	4.35	4.50	24		4.50	4.48	4.42
9		4.22	4.30	4.50	25	4.30	4.42	4.45	4.40
10		4.22	4.25	4.55	26	4.25	4.40	4.40	4.42
11		4.20	4.25	4.58	27	4.25	4.40	4.55	4.42
12		4.25	4.22	4.60	28	4.22	4.80	4.58	4.40
13		4.28	4.20	4.55	29	4.30	4.70	4.52	4.40
14		4.20	4.20	4.48	30	4.25	4.75	4.48	4.35
15		4.20	4.20	4.42	31	4.28	4.80		4.30
16		4.20	4.20	4.40					

BLUE RIVER NEAR KREMMLING, COLO.

This station was established July 21, 1904, by M. C. Hinderlider. It is located at the State highway bridge on the road between Kremmling and Dillon, Colo., distant from the two towns 22 and 20 miles, respectively. The station is below the mouth of all tributaries of any importance. A plain staff gage, graduated to feet and tenths, is attached vertically to the west face of the middle masonry pier near the downstream end. The gage reads from 2 to 11 feet, the 2-foot mark resting on the bed of the stream. It is read daily by Miss Kathryn Sexton. Discharge measurements are made from the downstream side of the two-span iron bridge to which the gage is attached. The initial point for soundings is a 40-penny nail driven into the downstream guard rail at the left end of the bridge immediately over the east face of the left abutment. It is marked zero, and the bridge floor is marked and numbered each 5 feet from zero to 167.7 feet. The channel is straight for about 400 feet above and 200 feet below the station, and the current is very swift and rough. Both banks are

lined with willows and are not subject to overflow. The bed of the stream is rough, there being several bowlders of considerable size which break the current. Otherwise it is clean and stable. There is one channel at all stages broken by the middle pier of the bridge. Owing to the roughness of the bed, the station is not a good one, but it is the only available point where an observer can be obtained. Bench mark No. 1 is a cross cut in the top of the second step from the top of the downstream wing of the left abutment. It is painted black and marked "U. S. B. M." Its elevation is 9.036 feet above the zero of the gage. Bench mark No. 2 is a 60-penny spike driven vertically into the west end of block to which the pulley is fastened. Its elevation is 11.68 feet above the zero of the gage.

On August 28, 1904, a regulation chain gage was established by W. A. Lamb to replace the wooden gage, the elevation of the datum of the two gages being the same.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Blue River near Kremmling, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 21	W. A. Lamb	160	271	3.70	3.10	1,0[illegible]
August 12	do	158	220	2.93	2.80	644
August 28	do	160	243	3.63	3.03	88[illegible]
October 8	do	154	134	2.49	2.40	33[illegible]

Mean daily gage height, in feet, of Blue River near Kremmling, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		2.90	2.80	2.55	17		2.95	2.50	2.4[illegible]
2		2.90	2.90	2.45	18		3.20	2.55	2.4[illegible]
3		2.85	2.90	2.40	19		3.20	2.50	2.[illegible]
4		2.85	2.70	2.40	20		3.00	2.30	2.[illegible]
5		2.85	2.55	2.40	21		2.90	2.35	2.[illegible]
6		2.85	2.50	2.40	22	3.20	3.00	2.40	2.[illegible]
7		2.80	2.48	2.45	23	3.10	2.90	2.40	2.[illegible]
8		2.80	2.45	2.40	24	3.10	2.85	2.50	2.[illegible]
9		2.80	2.40	2.50	25	3.20	2.80	2.45	2.[illegible]
10		2.75	2.45	2.50	26	3.20	2.80	2.58	2.[illegible]
11		2.75	2.35	2.40	27	3.05	2.95	2.60	2.[illegible]
12		2.85	2.45	2.40	28	3.00	2.95	2.55	2.[illegible]
13		2.90	2.40	2.40	29	3.05	2.60	2.50	2.[illegible]
14		3.00	2.40	2.40	30	3.05	2.75	2.50	2.[illegible]
15		3.05	2.30	2.40	31	2.98	2.80		2.[illegible]
16		2.90	2.50	2.40					

Rating table for Blue River near Kremmling, Colo., from July 22 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	240	2.45	365	2.70	545	2.95	785
2.25	260	2.50	400	2.75	585	3.00	850
2.30	280	2.55	435	2.80	625	3.10	1,000
2.35	305	2.60	470	2.85	670	3.20	1,185
2.40	335	2.65	505	2.90	725		

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904 and is fairly well defined.

Estimated monthly discharge of Blue River near Kremmling, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 22–31	1,185	824	999	19,820
August	1,185	470	727	44,700
September	725	280	411	24,460
October	435	260	327	20,110

TENMILE CREEK NEAR KOKOMO, COLO.

This station was established April 2, 1904, by R. I. Meeker, and is located at the wagon bridge at Admiral mine, 8 miles below Kokomo, Colo. This station replaces the station established by F. Cogswell at Uneva Lake, 2 miles below, on September 25, 1903. The station was changed on account of poor conditions at Uneva Lake. The drainage basin embraces an entirely mountainous area of 69 square miles. These mountains are very steep and rocky. The slopes in a considerable portion of this area have no soil formation whatever. This barren area is partly above timber line, but in many places below. The greater portion of run-off, perhaps 90 per cent, is from melting snows which fall from September to May.

The gage is a vertical 1 by 4 inch board nailed to the downstream side of the first pier from the left end of the bridge, and is graduated from zero to 4 feet in feet, tenths, and fiftieths; from 4 to 5.5 feet in feet and tenths. It is read twice each day by Don McFadgen. Discharge measurements are made at high water from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the left end of the bridge on the downstream side at the abut-

ment. Discharge measurements are made at low water by wading. The channel is straight for about 150 feet above and for 800 feet below the station. The current is sluggish at low water. Both banks are low, but are not subject to overflow. The right bank is covered with brush. The left bank is rocky, with scattered brush along the edge. There is one channel at high and several channels at low water. The bed of stream is of shifting sand.

The regulation of the flow of water into the Admiral mine power line at dam 600 feet below the station will interfere slightly with the gage heights. The bench mark is a circular hole cut in the top of a large boulder 80 feet downstream from the gage rod and just to the left of the Denver and Rio Grande Railway tracks. Its elevation is 9.66 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Tenmile Creek near Kokomo, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
April 2[a]	R. I. Meeker	8	10	1.00	0.97	1
April 23	do	46	53	1.53	1.55	8
May 31	do	73	220	2.37	3.57	52
June 29	do	67	142	1.76	2.44	25
August 5	do	38	54	1.44	1.18	7
September 3	do	36	47	1.34	1.00	6
November 5[b]	do		7	2.29	.54	1

[a] By wading.
[b] Measurement made in flume, and includes 3.5 second-feet flowing in old channel.

Mean daily gage height, in feet, of Tenmile Creek near Kokomo, Colo., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.98	1.83	3.49	2.48	1.19	1.25	0.80	0.60
2	.....	1.00	1.68	a3.10	2.34	1.25	1.11	.78	.64
3	.....	.96	1.70	2.80	2.28	1.22	1.04	.78	.62
4	.....	.92	1.46	2.36	2.15	1.24	.94	.77	.60
5	.....	.90	1.26	2.33	2.14	1.16	.89	a.80	.55
6	0.75	.85	1.30	2.53	2.08	1.18	.91	a.80	.55
7	.95	.85	1.48	2.94	2.15	1.16	.88	.80	.50
8	.85	.94	1.36	3.26	2.08	1.15	.81	.80	.50
9	.90	.93	1.33	3.00	2.10	1.12	.80	.78	.45
10	.95	.87	1.40	3.28	2.00	1.10	.80	.76	.45
11	.78	.58	1.74	3.95	2.00	1.16	.79	.73	.45
12	.78	.62	2.04	4.08	1.93	1.18	.74	.73	.45
13	.75	.70	2.35	4.20	1.96	1.18	.74	.74	.45
14	.88	.70	2.04	3.68	1.80	1.26	.72	.74	.45
15	.75	.76	2.28	3.70	1.80	1.29	.74	.72	.45
16	.78	.90	2.11	3.68	1.95	1.30	1.04	.68	.45
17	1.02	1.40	2.50	3.51	1.84	1.31	.90	.68	.45
18	1.02	1.95	3.05	3.35	1.65	1.74	.85	.68	.45
19	.78	1.80	3.88	3.65	1.60	1.39	.80	.72	.45
20	.75	2.04	4.11	3.36	1.59	1.16	.80	.70	.46
21	.82	1.89	3.91	3.23	1.58	1.28	.82	.70	.....
22	.91	1.70	4.39	3.17	1.49	1.24	.79	.70	.....
23	a.88	1.54	5.12	3.07	1.46	1.12	.80	.70	.....
24	.85	1.35	5.16	2.88	1.54	1.11	.78	.68	.....
25	.82	1.28	4.18	2.64	1.55	1.11	.76	.70	.....
26	.90	1.22	3.70	2.61	1.40	1.11	.76	.65	.....
27	.88	1.63	3.72	2.64	1.34	1.30	.74	.64	.....
28	.75	1.87	3.40	2.78	1.31	1.40	.71	a.65	.....
29	.76	1.76	4.45	2.84	1.41	a1.20	.72	a.70	.....
30	.78	1.84	4.09	2.80	1.34	a1.10	.96	.74	.....
31	1.05	.....	3.80	.....	1.19	1.00	.....	.55	.....

a Estimated.

Rating table for Tenmile Creek near Kokomo, Colo., from March 6 to May 17, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	1	1.05	16	1.50	73	1.90	140
.65	1	1.10	21	1.55	81	1.95	150
.70	2	1.15	27	1.60	89	2.00	160
.75	2	1.20	33	1.65	97	2.10	180
.80	3	1.25	39	1.70	105	2.20	200
.85	4	1.30	45	1.75	113	2.30	220
.90	6	1.35	52	1.80	122	2.40	240
.95	9	1.40	59	1.85	131	2.50	260
1.00	12	1.45	66				

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is not well defined.

Rating table for Tenmile Creek near Kokomo, Colo., from May 18 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.45	10	1.45	106	2.45	250	3.45	489
.50	14	1.50	111	2.50	260	3.50	503
.55	18	1.55	116	2.55	270	3.60	531
.60	22	1.60	121	2.60	280	3.70	560
.65	26	1.65	126	2.65	290	3.80	590
.70	31	1.70	131	2.70	301	3.90	620
.75	36	1.75	136	2.75	312	4.00	650
.80	41	1.80	142	2.80	323	4.10	680
.85	46	1.85	149	2.85	335	4.20	710
.90	51	1.90	156	2.90	347	4.30	745
.95	56	1.95	164	2.95	359	4.40	780
1.00	61	2.00	172	3.00	371	4.50	815
1.05	66	2.05	180	3.05	384	4.60	850
1.10	71	2.10	188	3.10	397	4.70	885
1.15	76	2.15	196	3.15	410	4.80	920
1.20	81	2.20	204	3.20	423	4.90	955
1.25	86	2.25	213	3.25	436	5.00	995
1.30	91	2.30	222	3.30	449	5.10	1,035
1.35	96	2.35	231	3.35	462	5.20	1,075
1.40	101	2.40	240	3.40	475		

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904, and is fairly defined. It has been extended above gage height 3.60 feet.

Estimated monthly discharge of Tenmile Creek near Kokomo, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 6–31	16	2	5.3	273
April	168	1	50.4	3,000
May	1,059	40	374	23,000
June	710	227	421	25,050
July	256	80	149	9,161
August	135	61	82.6	5,079
September	86	32	45.6	2,714
October	41	18	33.3	2,047
November 1–20	25	10	13.8	547
The period				70,870

GUNNISON RIVER NEAR CIMARRON, COLO.

This station was established September 18, 1903, by W. N. Sammis. It is located just above the Denver and Rio Grande Railroad bridge, about 1 mile from Cimarron, Colo., and about 1,000 feet above the mouth of Cimarron River. The chain gage is located on the upstream side of the railroad bridge near the center of the stream and about 100 feet below the gaging section. The gage reads from zero to 20 feet with two markers, the second marker being used above 10 feet gage heights. The length of chain from end of weight to center of first marker is 56.06 feet. The second marker is 46.06 feet from end of weight. The gage is read twice each day by G. C. Gates. Discharge measurements are made by means of a cable and car. A stay line is stretched across the river about 50 feet above the cable for the careful manipulation of the meter, as the velocity at the section is usually above 4 feet in the center of the stream. The bench mark is the top of southeast corner capstone of east masonry abutment of the Denver and Rio Grande Railroad bridge. A line is cut across the corner of the capstone to indicate the bench mark. The elevation of the bench mark is 56.52 feet above the zero of the gage. The right end of the cable is directly under the end of the bridge on the right bank. The initial point for soundings is the face of the rock cliff at left side of the stream. Distances are marked on a tagged wire above the cable. The channel is straight for 1,000 feet above, and 300 feet below the station. The current has a rapid velocity at the gaging section which increases about 200 feet below. Both banks are steep mountain slopes and will not overflow. There is one channel at all stages. The bed of the stream is composed of granite bowlders at sides and cobblestones and gravel between, and is not subject to change.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements on Gunnison River near Cimarron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 8	L. E. Foster	92	245	2.30	4.10	564
April 26	McConnell and Foster	95	474	4.26	7.10	2,018
May 6	R. I. Meeker	90	412	3.67	6.40	1,514
May 24	L. E. Foster	135	1,119	6.20	12.40	6,940
June 6	R. I. Meeker	80	511	4.76	7.95	2,435
June 17	L. E. Foster	85	632	5.65	9.45	3,569
June 28	do	85	488	4.22	7.45	2,060
July 8	R. I. Meeker	90	344	3.53	6.00	1,214
July 20	L. E. Foster	90	254	3.05	5.00	775
August 1	do	80	309	3.40	5.70	1,050
August 13	R. I. Meeker	94	373	3.37	6.25	1,258
September 2	L. E. Foster	90	401	3.56	6.58	1,427
September 14	R. I. Meeker	75	246	2.63	4.60	648

Mean daily gage height, in feet, of Gunnison River near Cimarron, Colo., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.[a]	Nov.[a]	Dec.[a]
1	4.00	3.80	7.20	9.90	6.95	5.75	6.65	6.10	4.45	[illegible]
2	4.00	4.00	6.90	9.95	6.95	5.75	6.50	5.92	4.42	[illegible]
3	3.95	4.00	6.55	9.60	6.60	5.85	6.25	5.52	4.50	[illegible]
4	4.00	4.10	6.50	8.85	6.55	5.95	6.05	5.45	4.55	[illegible]
5	3.90	4.10	6.50	8.30	6.30	6.00	5.70	5.25	4.48	.....
6	3.90	4.00	6.40	7.95	6.05	6.25	5.45	5.60	4.30	.....
7	4.15	4.10	6.45	8.15	6.05	6.45	5.10	6.35	4.35	.....
8	4.20	4.10	6.75	8.25	6.05	5.65	5.10	6.10	4.25	.....
9	4.25	4.10	7.00	8.55	5.85	5.55	4.95	6.48	4.32	.....
10	4.30	4.50	7.20	8.80	5.75	5.40	4.90	6.45	4.20	.....
11	4.30	4.55	7.40	8.80	5.60	5.55	4.73	6.20	3.70	.....
12	4.30	5.25	7.85	8.50	5.45	5.65	4.65	5.95	3.30	.....
13	4.30	6.05	9.10	8.90	5.40	5.65	4.67	5.82	3.30	.....
14	4.30	6.70	9.90	9.50	5.30	5.70	4.70	5.80	3.30	.....
15	4.20	7.30	9.65	9.75	5.35	5.85	4.58	5.70	3.30	.....
16	4.20	7.40	9.40	9.95	5.55	5.80	4.48	5.56	3.30	.....
17	4.10	7.70	9.60	9.75	5.40	5.93	4.48	5.50	3.30	.....
18	4.00	8.05	9.65	9.20	5.25	6.63	4.50	5.40	3.30	.....
19	4.00	8.40	9.85	8.90	5.05	6.55	4.42	5.00	3.30	.....
20	4.00	8.10	9.85	8.50	4.95	6.10	4.35	5.00	3.30	.....
21	4.00	7.30	9.85	8.20	4.85	5.80	4.35	5.00	3.45	.....
22	4.00	6.70	10.80	7.95	4.75	5.80	4.55	5.10	3.40	.....
23	3.90	6.40	11.30	7.60	4.70	5.60	4.70	5.05	3.45	.....
24	3.90	6.40	12.25	7.55	4.80	5.95	4.98	5.10	3.30	.....
25	3.80	6.30	11.85	7.50	4.80	6.25	4.90	4.98	3.38	.....
26	3.80	6.75	12.15	7.50	4.80	6.25	4.80	4.90	3.48	.....
27	3.80	7.70	11.15	7.55	4.80	6.10	4.75	4.75	3.45	.....
28	3.70	7.80	10.55	7.40	4.65	6.15	4.78	4.70	3.60	.....
29	3.70	7.70	10.00	7.35	5.05	6.00	4.80	4.65	4.00	.....
30	3.70	7.60	10.00	7.25	5.65	6.15	5.50	4.62	4.10	.....
31	3.70	.....	10.00	.....	5.90	6.00	.....	4.50	.....	.....

[a] Ice conditions October 19 to December 31.

Rating table for Gunnison River near Cimarron, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	410	4.70	685	5.80	1,070	7.80	2,280
3.80	430	4.80	715	6.00	1,170	8.00	2,420
3.90	450	4.90	745	6.20	1,270	8.50	2,820
4.00	475	5.00	775	6.40	1,370	9.00	3,250
4.10	505	5.10	805	6.60	1,490	9.50	3,700
4.20	535	5.20	835	6.80	1,610	10.00	4,180
4.30	565	5.30	870	7.00	1,730	10.50	4,700
4.40	595	5.40	910	7.20	1,860	11.00	5,250
4.50	625	5.50	950	7.40	2,000	11.50	5,850
4.60	655	5.60	990	7.60	2,140	12.00	6,450

The above table is applicable only for open-channel conditions. It is based upon 17 discharge measurements made during 1903 and 1904. It is well defined between gage heights 4.10 feet and 12.40 feet. The table has been extended below gage height 4.10 feet.

Estimated monthly discharge of Gunnison River near Cimarron, Colo., for 1904.

[Drainage area, 3,844 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	565	410	484	29,760	0.126	0.145
April	2,740	430	1,368	81,400	.356	.400
May	6,750	1,370	3,474	213,600	.904	1.04
June	4,130	1,895	2,890	172,000	.752	.839
July	1,700	670	995	61,180	.259	.298
August	1,520	910	1,146	70,460	.298	.343
September	1,520	580	805	47,900	.209	.233
October [a]	1,430	625	951	58,470	.247	.285
November [a]	640	330	437	26,000	.114	.127
The period				760,800		

[a] Ice conditions October 19 to November 30. Estimates are for open channel.

GUNNISON RIVER NEAR CORY, COLO.

This station was established April 30, 1903, by W. N. Sammis, assisted by F. Cogswell. It is located at the highway bridge on the road between Delta and Cory, Colo., and is about 6 miles east of Delta, Colo. It is about 1 mile above the mouth of Surface Creek. The chain gage is located on the downstream side of the right span, 90 feet from the right bank. The gage reads from zero to 20 feet with two markers, the second marker being used above 10-foot gage heights. The length of chain from end of weight to center of first marker is 24.12 feet, to center of second marker 14.12 feet. The gage is read twice each day by John Shea. Discharge measurements are made from the two-span highway bridge and its approach. The initial point for soundings is a brass tack in the hand rail at center of left pier, downstream side of bridge. The channel is straight for 300 feet above and 500 feet below the station. The right bank is high, wooded, and will not overflow. The left bank is low, and wooded, but will not overflow except at extreme high water. There is but one channel at all stages. The bed of the stream is composed of bowlders and cobble stones. The bench mark is the top edge of iron rim of the northwest pier, downstream side of bridge, marked at point of bench mark by white paint. The zero of the gage is 17.59 feet below the bench mark.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Gunnison River near Cory, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis-charge
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second*
April 12	L. E. Foster	188	692	2.15	6.45	1,4
April 22	do	203	952	3.32	7.58	3,1
May 2	R. I. Meeker	204	991	3.82	7.88	3,7
May 30	L. E. Foster	223	1,312	4.91	9.15	6,4
June 9	R. I. Meeker	214	1,117	4.03	8.30	4,5
June 24	L. E. Foster	212	998	3.94	8.00	3,9
July 2	do	195	833	2.64	7.10	2,2
July 12	R. I. Meeker	190	689	2.08	6.42	1,4
July 27	L. E. Foster	185	568	1.42	5.90	8
August 4	do	190	651	2.03	6.35	1,3
August 25	do	189	622	1.85	6.20	1,1
September 19	R. I. Meeker	189	593	1.45	5.80	8

Mean daily gage height, in feet, of Gunnison River near Cory, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.45	5.55	5.60	5.80	8.15	9.30	7.15	6.20	6.80	6.05	5.80	7
2	5.45	5.55	5.60	5.80	8.05	8.95	7.05	6.60	6.95	6.25	5.85	7
3	5.45	5.55	5.60	5.80	7.65	8.65	6.95	6.35	6.65	6.40	5.80	7
4	5.45	5.55	5.60	5.75	7.45	8.45	6.95	6.40	6.45	6.15	5.80	7
5	5.45	5.55	5.60	5.75	7.35	8.05	6.75	6.35	6.40	6.10	5.80	7
6	5.45	5.55	5.65	5.70	7.35	7.90	6.55	6.35	6.30	6.20	5.75	8
7	5.45	5.55	5.65	5.70	7.65	7.80	6.35	6.40	6.20	6.40	5.80	7
8	5.45	5.55	5.70	5.70	7.85	7.85	6.45	6.25	6.05	6.60	5.75	7
9	5.45	5.55	5.70	5.75	7.70	8.30	6.45	6.05	6.00	6.65	5.65	7
10	5.45	5.55	5.70	5.70	7.90	8.30	6.45	6.05	6.00	6.80	5.58	8
11	5.45	5.55	5.60	5.80	8.30	8.20	6.45	6.00	5.95	6.80	5.50	7
12	5.45	5.55	5.65	6.05	8.70	8.50	6.50	6.15	5.95	6.70	5.40	7
13	5.45	5.55	5.70	6.70	9.30	8.90	6.35	6.05	5.85	6.55	5.45	8
14	5.45	5.55	5.70	7.10	9.40	9.00	6.30	6.05	5.85	6.35	5.40	8
15	5.45	5.45	5.65	7.40	9.15	8.80	6.15	6.25	5.85	6.35	5.45	8
16	5.45	5.45	5.60	7.65	8.75	8.70	6.10	6.35	5.85	6.35	5.40	8
17	5.45	5.55	5.60	7.90	8.65	8.60	6.15	6.35	5.85	6.30	5.40	8
18	5.45	5.55	5.70	7.90	8.90	8.50	6.15	6.35	5.90	6.25	5.45	8
19	5.55	5.45	5.70	8.20	9.20	8.60	6.15	6.45	5.80	6.25	5.50	8
20	5.55	5.45	5.80	8.10	9.50	8.40	6.05	6.55	5.80	6.15	5.45	8
21	5.55	5.45	5.90	8.25	9.25	8.20	5.85	6.40	5.80	6.05	5.40	7
22	5.55	5.45	5.60	7.75	9.25	8.15	5.95	6.40	5.90	6.05	5.45	7
23	5.55	5.50	5.60	7.30	9.70	8.20	5.85	6.35	6.00	6.15	5.40	8
24	5.55	5.55	5.60	7.25	10.20	8.05	5.90	6.35	6.15	6.10	5.35	8
25	5.55	5.55	5.60	7.20	10.30	7.90	5.90	6.20	6.10	6.00	5.35	8
26	5.55	5.60	5.55	7.35	9.45	7.65	5.85	6.25	6.00	6.05	5.45	8
27	5.55	5.60	5.50	7.65	9.35	7.40	5.90	6.55	5.95	5.95	5.45	8
28	5.55	5.60	5.60	8.30	9.20	7.25	5.85	6.45	6.05	5.95	5.45	8
29	5.55	5.60	5.60	8.55	9.05	7.20	5.85	6.50	6.05	6.00	5.40	8
30	5.55	.....	5.70	8.40	9.15	7.20	5.90	6.50	6.05	5.90	5.45	8
31	5.55	.....	5.70	.....	9.20	.....	5.85	6.55	.....	5.85	.....	8

NOTE.—Slush ice during December.

Rating table for Gunnison River near Cory, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.50	540	6.80	1,930	8.10	4,220	9.40	7,450
5.60	620	6.90	2,080	8.20	4,440	9.50	7,760
5.70	700	7.00	2,230	8.30	4,670	9.60	8,080
5.80	790	7.10	2,380	8.40	4,900	9.70	8,400
5.90	880	7.20	2,530	8.50	5,140	9.80	8,720
6.00	970	7.30	2,690	8.60	5,380	9.90	9,050
6.10	1,070	7.40	2,860	8.70	5,620	10.00	9,390
6.20	1,180	7.50	3,040	8.80	5,860	10.10	9,750
6.30	1,290	7.60	3,220	8.90	6,110	10.20	10,110
6.40	1,400	7.70	3,410	9.00	6,360	10.30	10,480
6.50	1,520	7.80	3,610	9.10	6,610	10.40	10,860
6.60	1,650	7.90	3,810	9.20	6,880	10.50	11,260
6.70	1,790	8.00	4,010	9.30	7,160		

The above table is applicable only for open-channel conditions. It is based upon 22 discharge measurements made during 1903 and 1904, and is well defined between gage heights 5.70 feet and 9.00 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Gunnison River near Cory, Colo., for 1904.

[Drainage area, 5,233 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	580	500	534	32,830	0.102	0.117
February	620	500	568	32,670	.109	.118
March	880	540	658	40,460	.126	.145
April	5,260	700	2,422	144,100	.463	.516
May	10,480	2,775	5,905	363,100	1.13	1.30
June	7,160	2,530	4,594	273,400	.878	.980
July	2,455	835	1,287	79,140	.246	.284
August	1,650	970	1,321	81,230	.252	.290
September	2,155	790	1,079	64,200	.206	.230
October	1,930	835	1,248	76,740	.238	.274
November	835	470	578	34,390	.110	.123
December	580	310	422	25,950	.081	.093
The year	10,480	360	1,718	1,248,000	.328	4.47

GUNNISON RIVER AT WHITEWATER, COLO.

This station was established by J. E. Field, April 10, 1902, at the two-span steel wagon bridge constructed by the State of Colorado at a point about half a mile above the railroad station at Whitewater, on the Denver and Rio Grande Railroad. During 1895, 1897, and 1901 incomplete series of gage heights were obtained at this point, but the station was not regularly established until 1902. It was intended that this station should take the place of the one formerly maintained on the Gunnison at Grand Junction. The latter station was abandoned on account of inaccuracies that could not be overcome. They were mainly due to the fact that high stages of water in Grand River affected the gage rod in the Gunnison, and that the stream bed was partially filled with great bowlders, making accurate gagings impossible. The gage as originally established was of wire, on the downstream side of right span. On April 8, 1904, the old gage was replaced by a new chain gage with the same datum. The gage scale is graduated from zero to 10 feet, with two markers on the chain, giving a range of 20 feet in gage heights. The length of chain from end of weight to center of first marker is 21.59 feet. The second marker is 11.59 feet from end of weight and is used when the gage heights are above 10 feet. The gage is read twice each day by James Page, station agent at Whitewater. Discharge measurements are made from the downstream side of the bridge. The bed of the stream at cross section is good, being composed of sand, gravel, and cobblestones which are fairly permanent. There is a small area adjacent to some old sheet piling about the cylinder piers in the center of the river which fills in with silt during low water and scours out during high water. The width of section is 282 feet between masonry piers. At the center of the section the current is broken by cylinder piers and old sheet piling. The initial point for soundings is the edge of the capstone of the left masonry abutment on the downstream side of bridge.

The channel is straight for several hundred feet above and below the station. The right bank is high and not liable to overflow. The left bank will overflow at very high stages. On July 3, 1904, a standard United States Geological Survey iron bench mark was established by the topographic branch of the United States Geological Survey about 40 feet southeast of east end of bridge. It is stamped 4,653.6 feet above sea level. The zero of the gage is 16.83 feet below the bench mark.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Gunnison River at Whitewater, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 8	R. I. Meeker	190	374	2.26	4.00	844
April 29	do	265	1,263	3.69	7.05	4,656
June 3	do	282	1,397	3.89	7.55	5,438
July 3	do	257	831	2.67	5.45	2,220
August 9	G. B. Monk	255	537	2.08	4.57	1,118
August 9	R. I. Meeker	255	533	2.13	4.55	1,135
September 8	do	253	528	2.21	4.55	1,166

Mean daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.80	4.20	3.95	4.20	6.75	8.25	6.20	5.05	6.15	4.50
2	3.80	4.10	3.85	3.90	6.85	7.90	5.85	5.45	5.85	4.55
3	3.80	4.00	3.80	3.90	6.60	7.50	5.50	5.25	5.20	4.65
4	3.90	4.15	3.75	3.90	6.65	7.40	5.40	5.00	5.00	4.85
5	3.95	4.25	3.80	3.80	6.30	7.00	5.40	5.80	4.90	4.65
6	4.00	4.45	3.85	3.80	6.00	6.50	5.30	4.65	4.80	4.70
7	4.05	4.40	3.85	3.90	6.10	6.35	5.20	4.80	4.70	4.90
8	4.10	4.30	3.95	4.00	6.50	6.55	5.05	4.70	4.55	5.70
9	4.10	4.30	3.90	3.90	6.45	6.95	4.85	4.52	4.40	5.45
10	4.05	4.20	4.15	3.90	6.70	7.10	4.70	4.65	4.35	5.30
11	4.10	4.20	4.00	4.20	6.90	7.25	4.70	4.80	4.25	5.20
12	4.00	4.10	3.95	4.55	7.30	7.35	4.60	4.60	4.20	5.15
13	3.90	4.00	3.90	5.05	7.80	7.65	4.45	4.55	4.10	5.00
14	3.90	4.00	3.80	5.40	8.35	7.85	4.35	4.80	4.00	5.00
15	3.95	4.05	3.80	5.75	8.35	7.70	4.25	4.95	4.00	4.90
16	4.05	4.15	3.90	6.10	7.90	7.55	4.20	5.15	4.00	4.80
17	4.15	4.20	3.90	6.35	7.65	7.45	4.05	5.35	4.20	4.80
18	4.10	4.10	3.85	6.55	7.70	7.30	4.05	5.55	4.10	4.70
19	4.00	4.10	3.80	6.80	8.10	7.05	4.20	5.35	4.10	4.60
20	3.90	4.20	3.90	6.85	8.50	6.80	4.10	5.25	4.00	4.55
21	3.90	4.05	4.00	6.50	8.40	7.35	4.00	5.05	4.00	4.55
22	4.05	3.85	4.25	6.60	8.20	7.35	3.90	4.90	4.15	4.45
23	4.25	3.90	4.30	6.05	8.25	7.05	4.05	4.80	4.30	4.30
24	4.25	3.85	4.20	5.85	8.75	6.75	4.10	4.80	4.30	4.35
25	4.10	4.00	4.05	5.60	9.05	6.55	4.20	4.65	4.40	4.30
26	4.00	4.00	3.90	5.55	8.60	6.40	4.35	4.60	4.45	4.35
27	3.90	3.90	3.80	6.05	8.00	6.10	4.45	4.85	4.30	4.25
28	4.05	4.00	3.80	6.55	7.95	5.95	4.55	5.05	4.10	4.10
29	4.25	4.05	3.70	7.05	7.70	5.80	4.65	5.25	4.15	4.10
30	4.40	.....	3.85	7.05	7.80	5.75	4.75	5.40	4.35	4.15
31	4.30	.....	4.05	.....	8.15	.....	4.95	5.50	.....	4.05

Rating table for Gunnison River at Whitewater, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	510	5.10	1,740	6.40	3,530	7.70	5,8[illegible]
3.80	570	5.20	1,860	6.50	3,690	7.80	5,990
3.90	630	5.30	1,985	6.60	3,850	7.90	6,180
4.00	695	5.40	2,110	6.70	4,010	8.00	6,380
4.10	765	5.50	2,240	6.80	4,180	8.10	6,580
4.20	840	5.60	2,370	6.90	4,350	8.20	6,780
4.30	920	5.70	2,505	7.00	4,520	8.30	6,990
4.40	1,005	5.80	2,640	7.10	4,690	8.40	7,200
4.50	1,095	5.90	2,780	7.20	4,870	8.50	7,420
4.60	1,190	6.00	2,920	7.30	5,050	8.60	7,640
4.70	1,290	6.10	3,070	7.40	5,230	8.70	7,860
4.80	1,395	6.20	3,220	7.50	5,420	8.80	8,080
4.90	1,505	6.30	3,370	7.60	5,610	8.90	8,300
5.00	1,620						

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined between gage heights 4.50 feet and 8.00 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Gunnison River at Whitewater, Colo., for 1904.

[Drainage area, 7,868 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches
January	1,005	570	724	44,520	0.092	0.[illegible]
February	1,050	600	774	44,520	.098	.1[illegible]
March	920	510	648	39,840	.082	.0[illegible]
April	4,605	570	2,248	133,800	.286	.3[illegible]
May	8,630	2,920	5,623	345,700	.715	.8[illegible]
June	6,885	2,572	4,602	273,800	.585	.6[illegible]
July	3,220	630	1,319	81,100	.168	.194
August	2,640	1,095	1,642	101,000	.209	.24[illegible]
September	3,145	695	1,104	65,690	.140	.15[illegible]
October	2,505	730	1,301	80,000	.165	.1[illegible]
The period				1,210,000		

CIMARRON RIVER AT CIMARRON, COLO.

This station was established April 28, 1903, by W. N. Sammis. It is located at the footbridge 1,200 feet south of the Denver and Rio Grande Railroad station and about 1 mile above the entry of Cimarron River into Gunnison River. The gage is a vertical 1 by 6 inch rod, fastened to the left abutment on the downstream side. The gage is graduated to feet and tenths and reads from zero to 7 feet. It is read twice each day by G. L. Linscott. Discharge measurements are made from the footbridge, which is supported by two log abutments and one log pier in the center of the stream. The initial point for soundings is the left abutment on the downstream side. The channel is straight for 100 feet above and 250 feet below the station. Both banks are low and partly wooded, and have not been known to overflow for the past eight years. At low water there is but one channel, and all the water passes beneath the left span. At high water there are two channels, separated by the center pier of the bridge. The bed of the stream is stable and very rough, and is composed of large cobblestones and bowlders. The stream gradient is large, though somewhat uneven. The velocity at the section is always high. The drainage area is entirely mountainous. During summer and fall short heavy rain storms occur frequently and cause sudden fluctuations in gage heights, due to the rapid run-off induced by steep slopes of drainage basin. The bridge has a span between abutments of about 60 feet. The bench mark consists of two nails driven into the root of a cottonwood tree 50 feet west of the gage. Its elevation is 7.82 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Cimarron River at Cimarron, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 8	L. E. Foster	32	28	1.46	1.65	41
April 16	Foster and Meeker	32	47	4.49	2.25	211
April 27	McConnell and Foster	32	50	3.88	2.10	194
June 7	R. I. Meeker	43	79	4.90	2.75	387
June 16	L. E. Foster	46	80	5.32	2.88	426
June 27	do	31	47	4.38	2.25	206
July 9	R. I. Meeker	31	34	3.76	2.10	127
July 22	L. E. Foster	30	26	2.65	1.75	69
August 2	do	30	28	3.00	1.85	84
August 10	do	30	19	2.05	1.60	39
September 3	do	33	38	3.94	2.20	150
September 15	R. I. Meeker	33	22	2.55	1.75	56

Mean daily gage height, in feet, of Cimarron River at Cimarron, Colo., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.70	2.25	3.02	2.20	1.85	2.60	1.98	1.70
2		1.70	2.22	2.98	2.05	1.88	1.98	1.90	1.60
3		1.70	2.10	2.85	2.08	1.82	2.00	1.95	1.50
4		1.70	2.05	2.70	2.05	1.80	2.12	1.85	1.60
5		1.70	2.10	2.48	2.20	1.80	1.95	1.75	1.55
6		1.65	2.10	2.50	2.15	1.80	1.95	1.80	1.60
7		1.62	2.18	2.72	2.02	1.80	1.98	1.90	1.70
8		1.62	2.20	2.78	2.10	1.78	1.92	1.85	1.60
9		1.60	2.25	2.82	2.15	1.72	1.95	1.90	1.60
10		1.62	2.55	2.72	2.05	1.60	1.75	1.90	1.50
11		1.85	2.58	3.00	2.00	1.68	1.85	1.92	(a)
12		2.10	2.75	3.05	2.10	1.70	1.85	1.82	(a)
13		2.20	2.90	3.35	1.92	1.62	1.85	1.88	(a)
14		2.20	2.90	3.40	1.92	1.78	1.82	1.78	(a)
15		2.30	2.80	3.05	1.92	1.60	1.78	1.85	(a)
16		2.28	2.58	2.98	1.90	1.52	1.90	1.80	1.80
17		2.32	2.60	3.00	1.98	1.52	1.82	1.85	2.00
18		2.40	2.80	2.80	1.88	2.45	1.78	1.75	1.80
19		2.42	3.05	2.65	1.85	2.00	1.78	b1.70	(a)
20		2.28	3.05	2.92	1.80	1.80	1.82	1.70	(a)
21		2.35	3.05	2.90	1.78	1.85	1.75	1.65	.....
22		2.10	3.12	2.75	1.75	1.95	1.70	1.60	.....
23		2.10	3.30	2.65	1.78	1.78	1.70	1.65	.....
24	1.75	2.05	3.38	2.70	1.98	1.95	1.95	1.65	.....
25	1.75	1.95	3.20	2.65	1.80	1.82	1.65	1.60	.....
26	1.80	2.10	2.92	2.85	1.78	2.10	1.72	1.60	.....
27	1.75	2.18	3.08	2.30	1.80	2.00	1.82	1.65	.....
28	1.75	2.40	3.08	2.35	1.78	2.18	1.70	1.70	.....
29	1.72	2.48	3.08	2.38	1.88	1.85	1.75	1.70	.....
30	1.70	2.28	3.32	2.30	2.12	1.98	1.95	1.55	.....
31	1.62	.....	3.12	.....	1.92	2.05	.....	1.55	.....

[a] River frozen. [b] Ice conditions October 19 to December 31.

Rating table for Cimarron River at Cimarron, Colo., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.55	33	1.85	83	2.30	199	2.90	445
1.60	40	1.90	93	2.40	233	3.00	495
1.65	48	1.95	104	2.50	270	3.10	545
1.70	56	2.00	115	2.60	310	3.20	595
1.75	64	2.10	140	2.70	353	3.30	645
1.80	73	2.20	168	2.80	398	3.40	705

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904 and 3 high-water measurements made in 1903. It is not well defined, owing to the roughness of the channel.

Estimated monthly discharge of Cimarron River at Cimarron, Colo., for 1904.

[Drainage area, 210 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 24–31	73	43	60.9	968	0.290	0.087
April	262	40	135	8,033	.643	.717
May	693	127	387	23,800	1.84	2.12
June	785	199	402	23,920	1.91	2.13
July	168	64	108	6,641	.514	.593
August	251	29	85.2	5,238	.405	.467
September	310	48	91.1	5,420	.433	.483
October[a]	111	33	68.6	4,218	.329	.380
November 1–10[a]	56	26	39.7	787	.189	.070
The period				79,020		

[a] Estimates are for open channel October and November.

GUNNISON RIVER (NORTH FORK) NEAR HOTCHKISS, COLO.

This station, as originally established May 2, 1903, by W. N. Sammis, was located at the highway bridge one-half mile east of Hotchkiss, Colo. The gage was a vertical 2 by 4 inch rod, 3 feet long, nailed to the upstream side of the log abutment on the right bank. Another 3-foot section was nailed to the middle pier on the downstream side. This gage was read twice each day by Frank Visner. Discharge measurements were made from the two-span highway bridge and its approach. The initial point for soundings was the end of the hand rail on the downstream side at the left bank. The channel was straight for about 100 feet above and below the station, and the current was swift. The right bank was low and liable to overflow. The left bank was high and was not liable to overflow. The bed of the stream was rocky. The bench mark for this station was a bolt on the upstream side of the southwest pier on the right bank. It was marked "B. M. U. S. G. S." Its elevation was 8.58 feet above the zero of the gage.

Owing to unsatisfactory conditions, the station at the highway bridge was abandoned and a new station established April 13, 1904, by R. I. Meeker. It is located 4 miles below Hotchkiss, Colo., on the ranch of L. Gorsuch. The gage is an inclined 2 by 6 inch timber, graduated from zero to 7 feet in feet and tenths. It is located on the right bank about 1,000 feet downstream from the house of the observer, L. Gorsuch, who reads the gage twice each day.

It is held in place by 2 by 4 inch stakes and bowlders. Discharge measurements are made by means of a five-eighths inch iron wire cable and car, the property of the observer. The initial point for soundings is near the left end of cable, marked "0.0" with brass tag on the wire, which has the points for soundings marked with brass tags every 10 feet. The channel is straight for about 800 feet above and below the station and the current is swift. Both banks are low and rocky and are not liable to overflow. The right bank is clean and the left bank is partly wooded. The bed of the stream is composed of large and small cobblestones and some gravel, and is permanent. There are two channels at low, and one at high water. The drainage area is mountainous. In August and September practically the entire discharge of the river is diverted for irrigation above. The bench mark is a point on a large bowlder designated by a circle of white paint and marked "B. M." It is on the right bank of the stream, about 50 feet to the right of the gage. Its elevation is 9.34 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Gunnison River (North Fork) near Hotchkiss, Colo., in 1904.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 13	R. I. Meeker	143	190	3.43	2.90	65[illegible]
May 4	do	168	285	3.98	3.40	1,13[illegible]
June 1	L. E. Foster	170	386	4.33	3.70	1,67[illegible]
June 10	R. I. Meeker	164	256	3.97	3.28	1,01[illegible]
June 24	L. E. Foster	135	230	3.42	3.10	7[illegible]
July 13	R. I. Meeker	85	67	2.25	2.30	151
August 5	L. E. Foster	70	54	2.11	2.20	114
August 24	do	70	64	2.34	2.30	15[illegible]
September 18	R. I. Meeker	68	48	2.08	2.15	[illegible]

Mean daily gage height, in feet, of Gunnison River (North Fork) near Hotchkiss, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.90	2.00	2.70	2.40	3.78	3.68	2.78	2.22	2.88	2.58	2.25	2.20
2	2.90	2.00	2.65	2.30	3.65	3.55	2.75	2.25	2.75	2.52	2.22	2.20
3	2.90	2.00	2.60	2.30	3.52	3.55	2.65	2.28	2.52	2.48	2.20	2.20
4	2.90	2.00	2.60	2.30	3.48	3.42	2.60	2.18	2.42	2.40	2.25	2.25
5	2.90	2.00	2.60	2.40	3.42	3.60	2.60	2.20	2.38	2.35	2.28	2.28
6	2.90	2.00	2.60	2.40	3.45	3.32	2.60	2.20	2.30	2.40	2.25	2.30
7	2.90	2.00	2.60	2.40	3.75	2.25	2.55	2.20	2.30	2.70	2.25	2.30
8	2.90	2.00	2.55	2.50	3.70	3.32	2.55	2.12	2.30	2.68	2.20	2.30
9	2.90	2.00	2.45	2.50	3.70	3.45	2.50	2.30	2.22	2.65	2.20	2.25
10	2.90	2.00	2.40	2.50	3.88	3.32	2.42	2.18	2.20	2.62	2.20	2.20
11	2.90	2.00	2.30	2.60	4.05	3.45	2.40	2.12	2.20	2.60	2.28	2.20
12	2.90	2.00	2.20	2.60	4.32	3.50	2.32	2.10	2.15	2.60	2.32	2.20
13	2.90	2.00	2.20	2.90	4.40	3.60	2.30	2.25	2.10	2.60	2.32	2.20
14	2.90	2.20	2.20	3.08	4.38	3.58	2.30	2.35	2.08	2.55	2.30	2.15
15	2.90	2.40	2.40	3.30	4.15	3.52	2.28	2.50	2.05	2.55	2.25	2.18
16	2.90	2.45	2.40	3.32	4.00	3.52	2.20	2.40	2.10	2.50	2.25	2.22
17	2.90	2.60	2.40	3.40	4.08	3.50	2.20	2.40	2.10	2.50	2.25	2.30
18	2.90	2.70	2.50	3.52	4.10	3.42	2.18	2.52	2.18	2.45	2.20	2.35
19	2.90	2.70	2.50	3.68	4.15	3.28	2.15	2.58	2.20	2.45	2.20	2.30
20	2.90	2.70	2.50	3.42	4.12	3.40	2.12	2.50	2.20	2.40	2.20	2.25
21	2.90	2.70	2.60	3.62	3.95	3.35	2.32	2.55	2.20	2.40	2.20	2.20
22	2.90	2.70	2.60	3.32	3.98	3.22	2.05	2.40	2.20	2.40	2.25	2.18
23	2.90	2.80	2.60	3.28	4.10	3.15	2.00	2.38	2.42	2.40	2.25	2.15
24	2.90	2.80	2.60	3.25	4.22	3.10	2.08	2.30	2.60	2.35	2.30	2.20
25	2.90	2.80	2.60	3.20	4.02	3.05	2.00	2.32	2.42	2.35	2.30	2.20
26	2.90	2.80	2.60	3.32	3.90	2.98	2.00	2.35	2.40	2.35	2.30	2.20
27	2.90	2.80	2.60	3.55	3.88	2.95	1.98	2.30	2.38	2.32	2.25	2.10
28	2.90	2.80	2.50	3.88	3.72	2.88	1.95	2.32	2.35	2.30	2.25	2.18
29	2.90	2.80	2.50	3.95	3.65	2.88	2.00	2.40	2.35	2.30	2.25	2.20
30	2.90	.....	2.40	3.65	3.65	2.85	2.25	2.32	2.45	2.30	2.20	2.25
31	2.00	.....	2.40	.....	3.80	.....	2.35	2.32	.....	2.25	.....	2.25

Rating table for Gunnison River (North Fork) near Hotchkiss, Colo., from May 3, 1903, to April 12, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	45	2.80	394	4.00	1,395	5.10	3,220
1.70	55	2.90	443	4.10	1,530	5.20	3,430
1.80	70	3.00	495	4.20	1,675	5.30	3,655
1.90	88	3.10	550	4.30	1,825	5.40	3,890
2.00	108	3.20	610	4.40	1,980	5.50	4,140
2.10	133	3.30	680	4.50	2,140	5.60	4,400
2.20	162	3.40	760	4.60	2,305	5.70	4,670
2.30	195	3.50	845	4.70	2,475	5.80	4,950
2.40	230	3.60	940	4.80	2,650	5.90	5,240
2.50	267	3.70	1,045	4.90	2,830	6.00	5,530
2.60	306	3.80	1,155	5.00	3,020	6.10	5,820
2.70	348	3.90	1,270				

The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1903 and is well defined.

Rating table for Gunnison River (North Fork) near Hotchkiss, Colo., from April 13 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.95	52	2.35	171	3.10	785	3.80	1,850
2.00	61	2.40	195	3.20	910	3.90	2,030
2.05	72	2.50	255	3.30	1,050	4.00	2,210
2.10	85	2.60	325	3.40	1,190	4.10	2,390
2.15	100	2.70	395	3.50	1,340	4.20	2,570
2.20	116	2.80	475	3.60	1,500	4.30	2,770
2.25	133	2.90	570	3.70	1,670	4.40	2,970
2.30	151	3.00	675				

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904. It is well defined between gage heights 2.15 feet and 3.70 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Gunnison River (North Fork) near Hotchkiss, Colo., for 1904.

[Drainage area, 850 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	443	108	432	26,560	0.508	0.585
February	394	108	236	13,580	.277	.311
March	348	162	267	16,420	.314	.362
April	2,120	195	850	50,580	1.00	1.12
May	2,970	1,218	2,041	125,500	2.40	2.77
June	1,632	520	1,102	65,570	1.30	1.45
July	459	52	180	11,070	.212	.244
August	311	85	166	10,200	.195	.225
September	550	72	174	10,350	.205	.229
October	395	133	239	14,700	.281	.325
November	159	116	132	7,855	.155	.173
December	171	85	125	7,686	.147	.170
The year	2,970	52	495	360,100	.583	7.95

UNCOMPAHGRE RIVER NEAR COLONA, COLO.

This station was originally established April 23, 1903, by W. N. Sammis. It was located at a highway bridge one-half mile northeast of Colona, Colo. The gage consisted of a vertical 2 by 4 inch timber spiked to the log abutment on the downstream side near the left bank. Gage readings were taken twice each day by Chester Olsen, from April 26 to August 10, 1903. Discharge measurements were made from the two-span bridge to which the gage was attached. The initial point for soundings was the face of the log abutment on the left bank, at the downstream side. The bench mark is a nail in a cottonwood tree 6 inches in diameter and 50 feet northwest of the gage. It is marked "B. M. U. S. G. S." Its elevation is 9.65 feet above the zero of the gage.

On August 2, 1903, a dam was put in below the station for the purpose of diverting the water for irrigation. This backed up the water on the gage, and the station was discontinued August 10. It was reestablished on the same date by W. N. Sammis at Sam S. Kettle's bridge, about 1 mile south of Colona, Colo. The new gage is a vertical 2 by 4 inch timber nailed to the center pier of the two-span bridge, on the upstream side. It is read twice each day by Sam S. Kettle. Discharge measurements are made from the two-span wooden highway bridge at which the gage is located. The initial point for soundings is the face of the right abutment, on the downstream side of the bridge. The channel is straight for 100 feet above and for 50 feet below the station. The right bank is low and overflows at high water for a distance of 130 feet. The left bank is high and rocky and will not overflow. The bed of the stream is composed of gravel, free from vegetation, and is shifting. There are two channels at low and at high water. The bridge has a total span of about 60 feet between abutments. The bench mark is a nail driven in a blaze on a cottonwood tree. The tree is about 4 inches in diameter, and is about 75 feet northeast of the gage. The elevation of the bench mark is 4.49 feet above the zero of the gage.

Owing to unsatisfactory conditions at both high and low water, the station at Kettle's bridge was abandoned, and the station was reestablished April 9, 1904, by R. I. Meeker, at the private road bridge of J. M. Duckett, one-half mile above Eldredge Siding on the Denver and Rio Grande Railway and 3 miles above Colona, Colo. It is best reached by driving from Montrose. The gage is a 2 by 6 inch pine board 8 feet long, spiked vertically to the upstream side of the left abutment. It is graduated from zero to 7 feet in feet and tenths, the foot-marks having iron figures nailed at the side. Discharge measurements are made from the downstream side of the single span bridge, 46.2 feet long, to which the gage is attached. The initial point for

soundings is the downstream edge of the left abutment. The channel is straight for about 300 feet above and below the station. The current is swift. Both banks are rocky, partly wooded, and not subject to overflow. The bed of the stream is composed of rock and gravel and is clean and permanent. There is but one channel at all stages. The river has a uniform slope above and below the measuring section. The bench mark is the upper edge of a large screw set in an 8-inch willow tree about 3 feet above the ground. This tree is about 75 feet south and upstream from the right end of the bridge. Its elevation is 9.97 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Uncompahgre River near Colona, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 5 [a]	L. E. Foster		53	1.83	2.45	[illegible]
April 9	R. I. Meeker	45	38	2.26	.73	[illegible]
April 20	L. E. Foster	45	64	3.01	1.20	[illegible]
April 30 [a]	R. I. Meeker		66	2.97	2.70	[illegible]
April 30	do	45	60	3.40	1.12	[illegible]
May 26	L. E. Foster	46	99	4.21	1.90	[illegible]
June 8	R. I. Meeker	46	96	5.57	1.95	[illegible]
June 21	L. E. Foster	46	96	5.91	2.10	[illegible]
July 7	R. I. Meeker	46	74	3.86	1.58	[illegible]
July 30	L. E. Foster	46	63	2.83	1.30	[illegible]
August 12	G. B. Monk	46	67	3.13	1.35	[illegible]
August 22	L. E. Foster	46	78	4.28	1.65	[illegible]
September 1	do	46	94	6.14	2.12	[illegible]
September 13	R. I. Meeker	46	57	2.93	1.22	[illegible]

[a] Made at Kettles Crossing.

Mean daily gage height, in feet, of Uncompahgre River near Colona, Colo., for 1904.

Day.	Jan.c	Feb.c	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	a3.30	3.30	2.40	2.40	1.70	2.45	1.75	.....	2.15	1.40
2	3.30	3.30	2.40	2.40	1.45	2.65	1.75	.....	2.10	1.35
3	3.30	3.20	2.40	2.40	1.70	2.30	b1.75	.....	1.85	1.30
4	3.40	3.30	2.40	2.40	1.75	1.85	1.75	.....	1.75	1.30
5	3.20	3.30	2.40	2.40	1.55	1.65	1.75	.....	1.65	1.30
6	3.20	3.30	2.40	2.50	1.45	1.55	1.70	.....	1.60	1.35
7	3.30	3.35	2.40	2.40	1.70	2.10	1.50	.....	1.70	1.60
8	3.40	3.45	2.40	2.40	1.35	2.15	1.55	.....	1.35	1.40
9	3.40	3.40	2.40	2.40	1.35	2.00	1.85	.....	1.30	1.60
10	3.30	3.40	2.40	2.45	1.85	2.00	1.50	.....	1.25	1.45
11	3.40	3.40	2.40	2.60	1.60	2.00	1.45	.....	1.30	1.30
12	3.50	3.30	2.40	2.70	1.82	2.40	1.40	1.42	1.30	1.30
13	3.30	3.30	2.40	2.80	2.00	2.55	1.40	1.30	1.30	1.30
14	3.40	3.35	2.40	2.80	2.15	2.50	1.35	1.25	1.10	1.20
15	3.50	2.50	2.40	2.80	1.65	2.25	1.25	1.40	1.05	1.20
16	3.40	2.50	2.40	2.80	1.80	2.35	1.35	1.25	1.05	1.10
17	3.30	2.50	2.40	.85	1.75	2.35	.....	1.70	1.20	1.10
18	3.35	2.40	2.40	.75	1.95	2.55	.....	2.25	1.05	1.10
19	3.20	2.40	2.40	.72	2.25	b2.45	.....	2.00	1.05	1.10
20	3.35	2.40	2.40	.72	2.25	2.35	.....	1.75	.90	1.10
21	3.40	2.40	2.40	.78	2.30	2.45	.....	1.75	b1.10	1.10
22	3.40	2.40	2.40	.72	2.20	2.50	.....	1.65	b1.18	1.10
23	3.40	2.40	2.40	.72	2.60	2.30	.....	1.60	1.25	1.10
24	3.40	2.40	2.40	1.20	2.80	2.30	.....	1.60	1.15	1.10
25	3.40	2.40	2.40	1.20	2.30	2.30	.....	1.65	1.20	1.10
26	3.40	2.40	2.40	1.10	2.25	1.95	.....	1.75	1.20	1.10
27	3.40	2.40	2.40	1.20	2.35	1.75	.....	1.80	1.20	1.10
28	3.40	2.40	2.40	2.15	2.30	1.80	.....	1.90	1.10	1.00
29	3.40	2.40	2.40	1.50	2.45	2.25	.....	2.00	1.15	1.00
30	3.40	.....	2.40	1.75	2.45	1.75	.....	2.10	1.30	1.00
31	3.30	.....	2.40	.....	2.65	.....	.....	2.05	.....	1.00

a Readings from January 1 to April 16, inclusive, at Kettle's bridge. After April 16 they were taken at Eldredge Siding.
b Estimated.
c Ice conditions January 1 to February 15.

Rating table for Uncompahgre River at Kettle's crossing, near Colona, Colo., from August 11, 1903, to April 16, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	30	2.60	149	3.00	341	3.40	533
2.30	46	2.70	197	3.10	389	3.50	581
2.40	69	2.80	245	3.20	437	3.60	629
2.50	102	2.90	293	3.30	485	3.70	677

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904 between gage heights 2.50 feet and 2.70 feet. Above and below these limits the table is only approximate.

Rating table for Uncompahgre River at Eldredge siding, near Colona, Colo., from ... 17 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	64	1.20	163	2.00	530	2.70	1,1[illegible]
.75	71	1.30	192	2.10	600	2.80	1,240
.80	79	1.40	228	2.20	670	2.90	1,350
.85	87	1.50	269	2.30	750	3.00	1,460
.90	96	1.60	313	2.40	835	3.10	1,570
.95	106	1.70	360	2.50	930	3.20	1,680
1.00	116	1.80	410	2.60	1,030	3.30	1,790
1.10	138	1.90	470				

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1904. It is well defined between gage heights 0.70 foot and 2.10 feet. The table has been extended above gage height 2.1 feet.

Estimated monthly discharge of Uncompahgre River near Colona, Colo., for 1904.

[Drainage area, 433 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January [a]	581	437	513	31,540	1.18	1.[illegible]
February [a]	557	69	281	16,160	.649	.7[illegible]
March	69	69	69	4,243	.159	.[illegible]
April	635	69	149	8,866	.344	.[illegible]
May	1,240	209	567	34,860	1.31	1.[illegible]
June	1,080	291	691	41,120	1.60	1.[illegible]
July, 16 days	440	177	303	9,616	.700	.[illegible]
August, 20 days	710	177	382	15,150	.882	1.0[illegible]
September	635	96	224	13,330	.517	.[illegible]
October	313	116	172	10,580	.397	.[illegible]
The period				185,500		

[a] Estimates January and February are for open channel.

UNCOMPAHGRE RIVER AT MONTROSE, COLO.

This station was established April 22, 1903, by A. L. Fellows. It is located at the highway bridge west of Montrose and one-fourth mile west of the Denver and Rio Grande Railroad. The gage is a vertical 1 by 8 inch timber fastened to a wing dam 20 feet above the bridge. On April 15, 1904, the old rod was replaced by a new rod graduated to feet and tenths from zero to 8 feet. The zero of the new rod is identical with 1.45 feet on the old rod. The gage is read twice each day by Herbert Reeves. Discharge measurements are made from the highway bridge. The initial point for soundings is at the lower cylinder of the bridge on the left bank. The channel is straight for 300 feet above and below the station. There is but one channel at all stages, broken by two bridge piers at high water. The left bank is low and composed of earth. The right bank is low and composed of gravel. Both banks are subject to overflow. The bed of the stream is composed of gravel and cobblestones. The bench mark consists of two nails driven into a blaze on the root of a cottonwood tree. The tree is 50 feet east of the rod. The elevation of the bench mark is 8.51 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Uncompahgre River at Montrose, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 5	McConnell and Foster	21	17	0.83	1.15	14
April 25	L. E. Foster	20	24	1.46	1.70	35
May 21	do	34	63	4.25	3.10	268
June 8	R. I. Meeker	30	44	2.91	2.45	128
June 29	L. E. Foster	28	42	2.69	2.40	113
July 7	R. I. Meeker	25	31	1.87	2.05	58
July 23	L. E. Foster	18	17	.39	1.35	6.5
August 11	G. B. Monk	26	30	1.87	2.00	56
September 1	L. E. Foster	40	76	5.21	3.55	396
September 13	R. I. Meeker	26	31	2.16	2.10	67

Mean daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					1.80	3.22	2.18	2.58	3.60	2.35		
2					1.58	2.65	2.18	2.65	3.42	2.15		
3					1.52	2.32	2.15	2.65	3.08	2.20		
4					2.05	2.12	2.32	2.40	2.70	2.25		
5					2.08	2.02	2.02	2.10	2.50	2.35		
6					1.90	2.22	2.28	2.00	2.45	2.75		
7					2.18	2.25	2.25	2.02	2.40	3.50		
8					1.88	2.40	2.08	1.98	2.30	3.30		
9					1.78	2.55	1.98	2.02	2.25	3.15		
10					2.05	2.48	2.25	1.92	2.00	2.35		
11					2.00	2.85	2.30	1.92	1.98	2.15		
12					2.32	3.05	2.20	1.95	1.98	2.10		
13					2.70	3.02	2.20	1.95	2.10	2.00		
14					3.05	3.15	2.15	1.90	1.98	2.00		
15					2.60	2.88	2.08	2.10	1.92	1.95		
16					2.48	2.95	2.00	1.90	1.92	1.95		
17				2.35	2.22	2.65	1.98	2.20	1.85	1.50		
18				2.35	2.85	3.00	1.90	3.30	1.80	1.75		
19				2.30	3.15	2.92	1.85	2.85	1.80	1.75		
20				1.75	3.05	3.15	1.68	2.55	1.72	1.65		
21				1.90	2.92	3.15	1.50	2.35	1.78	1.70		
22				1.35	2.95	2.95	1.45	2.30	1.80	1.75		
23				1.50	3.55	2.72	1.38	2.25	1.90	1.80		
24				1.60	3.95	2.65	1.38	2.15	1.92	1.75		
25				1.65	3.40	2.60	1.40	2.10	1.82	1.75		
26				1.58	3.80	2.25	1.35	2.75	1.85	1.80		
27				1.62	3.18	2.18	1.40	2.60	1.85	1.72		
28				2.25	3.05	2.18	1.50	2.70	1.85	1.72		
29				2.22	2.68	2.25	2.70	3.00	2.52	1.75		
30				1.82	3.68	2.22	2.38	3.00	2.38	1.80		
31					3.42		2.32	2.92		1.80		

Rating table for Uncompahgre River at Montrose, Colo., from April 17 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.35	7	1.80	37	2.40	115	3.20	294
1.40	10	1.85	42	2.50	135	3.30	322
1.45	13	1.90	47	2.60	155	3.40	351
1.50	16	1.95	52	2.70	177	3.50	381
1.55	19	2.00	57	2.80	199	3.60	412
1.60	22	2.10	69	2.90	221	3.70	444
1.65	25	2.20	82	3.00	244	3.80	476
1.70	29	2.30	97	3.10	268	3.90	510
1.75	33						

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904, and is well defined.

Estimated monthly discharge of Uncompahgre River at Montrose, Colo., for 1904.

[Drainage area, 565 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 17–30	106	7	51.2	1,422	0.090	0.046
May	527	17	190	11,680	.336	.387
June	300	59	169	10,060	.299	.334
July	177	7	61.2	3,763	.108	.124
August	322	47	119	7,317	.211	.243
September	412	31	96.3	5,730	.170	.190
October	381	16	83.1	5,120	.147	.170
December	115	89	105	6,456	.186	.214
The period				51,550		

UNCOMPAHGRE RIVER AT DELTA, COLO.

This station was originally established April 29, 1903, by W. N. Sammis. It was located at a highway bridge one-fourth mile above the Denver and Rio Grande Railroad bridge. The discharge at this point did not include the mill-ditch waste. On November 17, 1903, the station was reestablished at the Denver and Rio Grande Railroad bridge, one-fourth mile northwest from the Denver and Rio Grande Railroad station. The new location was selected for the reason that the discharge of the river at this point includes the mill-ditch waste. This gage consisted of a 2 by 4 inch vertical rod nailed to a 12-inch pile on the downstream side of the railroad bridge. It read from 1 foot to 6 feet. Readings from this gage were taken until April 21, 1904, when an inclined gage was installed on the right bank, 45 feet east of the center of the Denver and Rio Grande Railroad track at the south approach to the bridge. This gage is a 2 by 6 inch rod, graduated by feet and tenths to 6 feet. The bottom of the rod is on the river bottom, and is held in place by six 2 by 4 inch timbers, driven firmly into the bank. Rock is also piled about the bank and around the gage to protect the earth from washing away. One vertical foot equals 1.79 feet on the slope of the rod. There is no definite and constant relation between new and old rods, as cross sections are not identical. Up to November 17, 1903, discharge measurements were made at the highway bridge to which the original gage was attached, or by wading near the gage. After November 17 discharge measurements were

made at Denver and Rio Grande Railroad bridge. Discharge measurements are now made from the road bridge, 100 feet below new gage.

The initial point for soundings is the face of the north abutment at the downstream side of the road bridge, and is marked by a brass-headed nail in the hand rail. During low water discharge measurements are made by wading near the bridge. The channel is straight for about 75 feet above and for 50 feet below the station. The current is sluggish. The right bank is high and clean, and is not subject to overflow. The left bank is low and clean, and might overflow during high water. There is but one channel at all stages. The bed of the stream is composed of earth and fragments of rock, and is fairly permanent. The bench mark for the vertical gage was a cross on the top of the lower chord of the bridge over gage rod. Its elevation was 8.75 feet above the zero of the gage. The bench mark for the inclined gage is a point marked with black paint and the letters "B. M." on the surface of the northeast corner of the stone abutment where the south end of the steel bridge rests, downstream side. Its elevation is 7.36 feet above the zero of the gage. Excluding discharge of seasonal high water in May or June, and an occasional rise from local storms, the water passing this station is entirely seepage water from irrigation above. The observer is Michael O'Rourke.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Uncompahgre River at Delta, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis-charge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 11	R. I. Meeker	9	4	1.75	[a] 1.85	7
May 2	do	9	2.8	1.32	.65	3.7
May 28	L. E. Foster	22	12	2.17	.9	26
June 9	R. I. Meeker	45	26	.42	.80	11
June 23	L. E. Foster	35	27	.78	.9	21
July 12	R. I. Meeker	25	21	.20	.65	4.2
August 24	L. E. Foster	35	29	.33	.7	9.6
September 17	R. I. Meeker	44	29	.52	.85	15
December 28 [b]	I. W. McConnell	33	57	2.10	1.40	121

[a] Old gage. [b] Velocities by floats, on account of ice.

Mean daily gage height, in feet, of Uncompahgre River at Delta, Colo., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.92	3.20	2.18	1.88	0.49	0.89	0.71	0.68	3.15	1.06	1.12	1.49
2	2.92	3.20	2.10	1.88	.55	.88	.70	.69	2.42	.96	1.02	1.54
3	2.98	3.20	2.05	1.89	.61	.70	.69	.69	1.85	.98	1.01	1.53
4	3.10	2.98	2.05	1.88	.59	.69	.67	.69	1.60	.92	1.02	1.58
5	3.05	2.82	2.02	1.84	.66	.67	.66	.70	1.28	.91	1.01	1.61
6	3.05	2.82	2.00	1.82	.62	.63	.65	.69	1.06	1.02	1.00	1.55
7	3.00	2.78	2.00	1.80	.66	.62	.64	.69	1.04	2.25	1.03	1.53
8	3.00	2.75	1.99	1.82	.64	.66	.63	.69	.99	1.29	1.08	1.49
9	2.95	2.70	1.99	1.84	.70	.74	.62	.67	.95	1.34	1.09	1.52
10	3.02	2.75	1.99	1.86	.65	.72	.62	.65	.92	1.39	1.08	1.62
11	3.05	2.75	1.98	1.87	.62	.66	.60	.64	.92	1.32	1.10	1.55
12	3.00	2.85	1.95	1.79	.57	.74	.59	.67	.92	1.33	1.08	1.60
13	3.00	2.75	1.95	1.66	.56	.73	.58	.64	.90	1.33	1.11	1.68
14	3.00	2.80	1.94	1.67	.60	1.22	.56	.63	.86	1.28	1.11	1.62
15	3.22	2.90	1.93	1.67	.66	1.12	.56	.62	.84	1.20	1.42	1.58
16	3.22	2.90	1.94	1.66	.60	.82	.59	.60	.80	1.19	1.59	1.52
17	3.25	2.95	1.89	1.62	.56	.83	.56	.64	.77	1.18	1.44	1.50
18	3.25	2.85	1.85	1.58	.53	.83	.55	.94	.82	1.18	1.39	1.54
19	3.10	2.80	1.83	1.56	.49	.89	.56	1.16	.84	1.18	1.32	1.56
20	2.95	2.75	1.82	1.54	.82	1.30	.56	.92	.84	1.19	1.22	1.59
21	3.02	2.70	1.86	1.49	.56	1.08	.57	.82	.87	1.20	1.17	1.58
22	3.08	2.72	1.84	[b].50	.51	1.02	.57	.78	.97	1.19	1.18	1.68
23	3.18	2.72	1.84	.54	.55	.96	.57	.72	1.04	1.18	1.21	1.65
24	3.08	2.68	1.82	.52	1.42	.89	.57	.70	.95	1.19	1.24	1.61
25	3.05	2.60	1.85	.48	1.50	.86	.56	.70	.90	1.22	1.29	1.60
26	3.05	2.52	1.85	.45	.86	.85	.56	1.31	.88	1.25	1.30	1.54
27	3.15	2.42	1.84	.45	.68	.81	.56	.88	.86	1.20	1.40	1.44
28	3.22	2.30	1.86	.45	.71	.77	.54	.85	.94	1.18	1.44	1.40
29	3.15	2.25	1.89	.48	.66	.73	.74	.90	.96	1.16	1.48	1.40
30	3.25	.....	1.89	.50	.63	.70	.72	1.02	.99	1.19	1.50	[c]1.40
31	3.20	.....	1.88	.....	.86	.....	.68	1.09	.....	1.24	.....	[c]1.40

[a] Gage readings January and February of little value on account of ice condition.
[b] Readings after April 21 at new station.
[c] Ice December 30 and 31.

Rating table for Uncompahgre River at Delta, Colo., from March 1 to April 21, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	1	1.70	3	1.90	10	2.10	22
1.60	2	1.80	6	2.00	15	2.20	30

The above table is applicable only for open-channel conditions. It is based upon 3 discharge measurements made during 1903 and 1904. The table has been extended below gage height 1.85 feet.

Rating table for Uncompahgre River at Delta, Colo., from April 22 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	1	0.75	8	1.00	35	1.40	120
.55	2	.80	11	1.10	50	1.50	145
.60	3	.85	15	1.20	70	1.60	170
.65	4	.90	21	1.30	95	1.70	195
.70	6	.95	27				

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage height 0.65 foot and 1.40 feet. The table has been extended beyond these limits. Estimates above gage height 1.70 feet made on the basis that the rating curve is a tangent, the difference being 25 per tenth.

Estimated monthly discharge of Uncompahgre River at Delta, Colo., for 1904.

[Drainage area, 1,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	28	7	12.0	738	0.011	0.01
April	10	1	4.2	250	.0037	.00
May	145	1	12.7	781	.011	.01
June	95	3	19.4	1,154	.017	.01
July	8	2	3.4	209	.0030	.00
August	98	3	15.3	941	.014	.01
September	557	9	67.0	3,987	.059	.06
October	332	22	77.5	4,765	.069	.07
November	168	35	78.0	4,641	.069	.07
December	190	120	156	9,592	.138	.15
The period				27,060		

SAN JUAN RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904, by M. C. Hinderlider. It is located at the suspension footbridge at the Methodist Indian school, about 3 miles south of Farmington, N. Mex., and about 2 miles below the mouth of Animas River. A standard wire gage is attached to a framework extending from the top of a sandstone cliff, about 15 feet above low water, on the right bank of the river 300 yards above the bridge. The gage scale is placed horizontally o

the top of the cliff and is graduated to feet and tenths from zero to 20 feet. The length of the wire from the end of the weight to the marker is 20.29 feet. Discharge measurements are made from the suspension footbridge. The bridge is 345 feet long and marked on the floor every 5 feet with black paint. The initial point for soundings is the south face of the main bridge support on the right bank of the river marked "0 initial point" with black paint. The channel is straight for about 900 feet above and below the station. The current is swift at high, and medium at low, stages. The right bank is a high sandstone cliff and can not overflow. The left bank at low water is a gravel bar extending out to 325 feet from the initial point for soundings, when it rises to a height of 6 feet. It probably never overflows beyond this point. The bed of the stream is composed of cobblestones, shale, and a few scattering large bowlders. It is clean and permanent. There is but one channel at all stages. The bench mark is a cross painted black on the top of the sandstone cliff, about 50 feet east of the gage. It is marked "U. S. G. S. B. M." Its elevation is 12.79 feet above the gage datum. The top of the gage rod (above the brace) is 0.825 foot above the bench mark. The marker is a knot tied in the wire near the ring.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of San Juan River near Farmington, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 19	M. C. Hinderlider	248	431	3.40	4.40	1,465
July 2	R. C. Prewitt	244	314	2.18	3.83	684
July 9	do	237	224	1.60	3.36	359
July 18	do	38	37	1.65	2.80	61
July 27	do	235	241	1.82	3.59	438
August 3	do	250	539	4.49	4.95	2,421
August 19	do	255	582	5.55	5.30	3,231
August 22	do	247	405	3.11	4.65	1,259
September 3	do	252	514	4.93	5.00	2,533
September 10	do	245	345	3.23	4.39	1,116
September 20	do	238	241	2.15	4.15	518
September 30	do	255	580	6.02	5.50	3,494
October 13	do	285	809	5.89	6.00	4,767

NOTE.—See page 228 for other measurements of San Juan River.

Mean daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.85	4.72	5.45	7.65	4.60	3.30
2		3.75	4.85	5.48	6.65	4.55	3.85
3		3.70	5.10	5.10	5.90	4.60	3.90
4		3.70	4.80	4.85	5.20	4.60	3.70
5		3.65	5.55	4.35	5.15	4.50	3.35
6		3.60	5.30	4.35	5.35	4.50	3.13
7		3.55	4.65	4.60	6.85	4.45	3.25
8		3.35	5.25	4.58	[a]8.60	4.60	3.10
9		3.32	5.65	4.55	[b]12.00	4.53	3.05
10		3.32	5.50	4.48	[b]9.00	4.45	3.70
11		3.20	5.30	4.15	[b]8.00	4.43	2.90
12		3.02	4.95	4.15	[b]7.00	4.55	2.95
13		2.92	4.95	4.20	6.55	4.35	3.00
14		2.82	4.95	4.25	6.60	4.20	3.10
15		2.70	4.95	4.20	6.60	4.10	3.20
16		2.65	5.00	4.18	6.50	4.15	3.25
17		2.65	5.05	4.22	6.30	4.00	3.30
18		2.70	6.10	4.25	6.20	4.10	3.38
19	4.30	2.68	5.70	4.22	6.15	4.20	3.75
20	4.25	2.65	5.60	4.05	5.90	3.95	3.40
21	4.25	2.65	5.10	4.15	5.80	4.00	3.32
22	4.15	2.62	4.65	4.05	5.90	3.75	3.38
23	4.20	2.60	4.68	4.25	5.80	3.90	3.35
24	4.15	2.65	4.68	4.60	5.85	3.80	3.28
25	4.05	3.55	5.10	4.35	5.85	3.90	3.35
26	4.15	4.10	4.82	4.35	5.80	3.85	3.32
27	3.90	3.65	4.88	4.50	5.80	3.90	3.72
28	3.95	3.52	4.85	4.70	5.55	3.90	3.75
29	3.95	3.55	4.78	4.65	5.45	3.95	3.62
30	3.90	4.48	4.85	7.55	5.35	3.90	3.22
31		4.35	5.80		5.20		3.20

[a] Gage washed away October 8; reestablished October 13.
[b] Gage heights estimated October 9 to 12.

Rating table for San Juan River near Farmington, N. Mex., from June 19 to August 18, 1904, and from November 9 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	20	3.20	230	4.20	1,150	5.20	2,970
2.65	27	3.30	290	4.30	1,300	5.30	3,190
2.70	35	3.40	350	4.40	1,450	5.40	3,410
2.75	45	3.50	420	4.50	1,610	5.50	3,630
2.80	55	3.60	500	4.60	1,780	5.60	3,850
2.85	70	3.70	580	4.70	1,950	5.70	4,070
2.90	90	3.80	680	4.80	2,140	5.80	4,290
2.95	110	3.90	780	4.90	2,340	5.90	4,520
3.00	130	4.00	900	5.00	2,540	6.00	4,750
3.10	180	4.10	1,020	5.10	2,750	6.10	4,980

The above table is based upon 9 discharge measurements made during 1904. It is well defined between gage heights 2.70 feet and 6.00 feet.

Rating table for San Juan River near Farmington, N. Mex., from August 19 to November 8, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	350	4.80	1,775	6.10	5,000	7.40	8,250
4.05	400	4.90	2,000	6.20	5,250	7.50	8,500
4.10	450	5.00	2,250	6.30	5,500	7.60	8,750
4.15	525	5.10	2,500	6.40	5,750	7.70	9,000
4.20	600	5.20	2,750	6.50	6,000	7.80	9,250
4.25	680	5.30	3,000	6.60	6,250	7.90	9,500
4.30	770	5.40	3,250	6.70	6,500	8.00	9,750
4.35	860	5.50	3,500	6.80	6,750	8.10	10,000
4.40	950	5.60	3,750	6.90	7,000	8.20	10,250
4.45	1,050	5.70	4,000	7.00	7,250	8.40	10,750
4.50	1,150	5.80	4,250	7.10	7,500	8.60	11,250
4.60	1,350	5.90	4,500	7.20	7,750	8.80	11,750
4.70	1,550	6.00	4,750	7.30	8,000	9.00	12,500

The above table is based upon 5 discharge measurements made during 1904. It is poorly defined. The table has been extended above gage height 6 feet. Above gage height 5 feet the rating curve is a tangent, the difference being 250 per tenth.

Estimated monthly discharge of San Juan River near Farmington, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 19–30	1,300	780	1,030	24,520
July	1,578	20	375	23,060
August	4,980	1,450	2,627	161,500
September	8,625	400	1,375	81,820
October	20,000	2,625	5,935	364,900
November	1,695	630	1,087	64,680
December	780	90	348	21,400
The period				741,900

ANIMAS RIVER AT DURANGO, COLO.

The station was first established June 20, 1895, and has been maintained during the greater part of each year since.

The original gage was located at the old wagon bridge, one-fourth mile west of the railroad bridge at Durango and about 200 feet above the Rio Grande Southern Railroad bridge. It was spiked to the west

side of the south end of the middle pier of the wagon bridge. The head of a bolt at the east abutment of the railroad bridge is 17.24 feet above this gage datum. During the early part of 1899 the old wagon bridge was removed and a new one erected a short distance below. April 1, 1899, on the central pier of this bridge a new rod, which consisted of a vertical piece of timber graduated to feet and tenths, was fastened. The bench marks were three horizontal strips, opposite the 10, 14, and 16.7 foot marks of the rod, respectively. Owing to this change in location and height of the rod there is no apparent relation between the rating tables before 1899 and the rating tables for 1899 and after.

The present gage was established June 20, 1901, by A. P. Davis. It is located at the new wagon bridge, one-fourth mile west of the railroad station at Durango, Colo. It is a vertical 2 by 6 inch timber 14 feet long. It is fastened to the masonry pier on the downstream side of the bridge, and is held in place by means of spikes driven into cracks in the masonry. It is read twice each day by C. G. Graden. On April 1–2, 1903, sand and gravel were washed down by Lightner Creek, which enters about 100 feet below the bridge, and were deposited around the gage rod. A new wire gage was established April 14, 1903, on the downstream side of the bridge in the span next the left bank. This gage was read until June 6, when it was stolen. In the meantime the sand and gravel had been washed away from the foot of the old gage, from which readings were taken for the remainder of the year. The wire gage read zero when the vertical gage read 5 feet. All 1903 readings have been reduced to the datum of the vertical gage. The 1903 rating table was prepared from measurements made after the deposit of sand and gravel had been scoured from around the vertical gage. It is therefore not applicable to gage heights taken previous to May 1, during which period the section at the gage was filled in. Discharge measurements are made from the bridge to which the gage is attached, except at low water, when they are made by wading. The initial point for soundings is the downstream edge of the right abutment. The channel is straight for 300 feet above, and 400 feet below, the station. The current is rough and has a rapid velocity. Both banks are high, rocky, and not liable to overflow. The bed of the stream is rocky and fairly permanent. Bench mark No. 1, established June 25, 1900, is a chiseled point at the southwest corner of the center pier of the highway bridge. Its elevation is 16.75 feet above the zero of the gage. Bench mark No. 2, established on the same date, is a similar point on the lower side of the left abutment. Its elevation is 16.84 feet above the zero of the gage. This relation was verified April 17, 1901.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Animas River at Durango, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 12	G. B. Monk	150	196	1.96	7.15	384
August 20	R. I. Meeker	150	256	2.97	7.60	760

Mean daily gage height, in feet, of Animas River at Durango, Colo., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		7.70	8.20	8.60	7.60	7.10
2		7.80	8.20	8.20	7.60	7.10
3		7.80	8.20	8.00	7.60	7.10
4		7.80	8.00	7.90	7.50	7.10
5		7.60	7.90	7.60	7.50	7.10
6		7.60	7.70	8.45	7.50	7.10
7	7.30	7.50	7.70	9.20	7.50	7.10
8	7.30	7.60	7.50	9.60	7.50	7.10
9	7.30	7.60	7.40	10.00	7.40	7.10
10	7.30	7.50	7.40	9.80	7.30	7.10
11	7.30	7.90	7.40	9.80	7.30	7.00
12	7.20	7.70	7.40	9.60	7.30	7.00
13	7.20	7.80	7.30	9.60	7.20	7.00
14	7.20	7.90	7.40	9.20	7.20	7.00
15	7.20	7.80	7.30	8.70	7.20	7.00
16	7.10	7.70	7.30	8.40	7.20	7.00
17	7.20	7.60	7.30	8.20	7.20	7.00
18	7.20	7.60	7.30	8.20	7.20	.....
19	7.00	7.70	7.30	8.10	7.20	.....
20	7.00	7.70	7.20	8.00	7.20	.....
21	7.00	7.60	7.20	8.00	7.20	.....
22	7.00	7.50	7.20	8.00	7.20	.....
23	7.20	7.40	7.40	8.00	7.20	.....
24	7.30	7.80	7.50	7.90	7.20	.....
25	7.30	7.70	7.50	7.90	7.10	.....
26	7.30	7.60	7.50	7.80	7.20	.....
27	7.30	8.00	7.40	7.70	7.20	.....
28	7.20	8.10	7.40	7.70	7.20	.....
29	7.20	8.00	7.55	7.70	7.20	.....
30	7.50	8.10	8.40	7.60	7.10	.....
31	7.50	8.20	.....	7.60	.....	.....

Rating table for Animas River at Durango, Colo., from January 1 to December 31, 19

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.50	122	7.10	362	8.10	1,285	9.10	2,420
6.55	136	7.20	429	8.20	1,395	9.20	2,550
6.60	150	7.30	504	8.30	1,505	9.30	2,680
6.65	164	7.40	586	8.40	1,615	9.40	2,810
6.70	179	7.50	672	8.50	1,725	9.50	2,940
6.75	195	7.60	761	8.60	1,835	9.60	3,070
6.80	213	7.70	854	8.70	1,950	9.70	3,210
6.85	234	7.80	955	8.80	2,065	9.80	3,350
6.90	257	7.90	1,065	8.90	2,180	9.90	3,490
6.95	281	8.00	1,175	9.00	2,300	10.00	3,630
7.00	306						

The above table is applicable only for open-channel conditions. It is based up 8 discharge measurements made during 1903 and 2 measurements made in 1904. I is well defined between gage heights 6.75 feet and 8.10 feet. The table has be extended below gage height 6.75.

Estimated monthly discharge of Animas River at Durango, Colo., for 1904.

[Drainage area, 812 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
July 7–31	672	306	453	22,460	0.558	0.5
August	1,395	586	903	55,520	1.11	1.2
September	1,615	429	738	43,910	.909	1.1
October	3,630	761	1,679	103,200	2.07	2.3
November	761	362	511	30,410	.629	.7
December 1–17	362	306	339	11,430	.417	.2
The period				266,900		

ANIMAS RIVER AT AZTEC, N. MEX.

This station was established June 21, 1904, by M. C. Hinderlider. It is located at the wagon bridge about three-eighths of a mile west of Aztec, N. Mex. A plain staff gage, graduated to feet and tenths from 2 to 10 feet, is spiked vertically to the downstream side of the north face of the pile bent under the right or south end of the main bridge truss, the 2-foot mark resting on the river bed. It is read twice each day by G. A. Black. Discharge measurements are made at high water from the downstream side of the wooden truss bridge, consisting of one truss 110 feet long, reached by approaches at either end resting on pile bents. The bridge floor is marked with black paint at each 5 feet from zero to 195 feet. The initial point for soundings is the head of a large nail in the top of the floor of the east approach, on the downstream side of the bridge, marked with black paint zero. At extremely low water measurements may be made by wading above or below the bridge.

The channel is straight for 600 feet above and 1,000 feet below the station, and the current is moderate. The right bank is a gradually sloping loam and gravel bank, rising about 4 feet above low water. It is covered with cottonwood trees and brush, and rarely overflows. The left bank rises abruptly from the water about 5 feet and does not overflow. The bed of the stream is composed of cobblestones and a light deposit of silt. It is free from vegetation, uniform, and fairly permanent. There is one channel at all stages, broken by a crib pier near the south side of the stream, and also four sets of piles under the south end of the bridge. The river forks about 100 feet above the bridge, there being an island at high stages. The bench mark is a 20-penny nail driven into the northeast root of a 30-inch cottonwood tree standing about 100 feet southwest of the end of the bridge on the right bank. Its elevation is 7.14 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Animas River at Aztec, N. Mex., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 20	M. C. Hinderlider	116	342	2.60	4.67	[illegible]
July 7	R. C. Prewitt	102	227	1.36	3.89	[illegible]
July 10	do	101	205	1.28	3.69	[illegible]
July 17	do	101	192	.94	3.52	[illegible]
July 24	do	101	172	.80	3.39	[illegible]
August 2	do	109	232	2.37	4.31	[illegible]
August 16	do	140	285	2.94	5.38	[illegible]
August 25	do	130	283	3.30	5.23	[illegible]
September 5	do	121	258	2.83	4.80	[illegible]
September 9	do	112	188	2.59	4.38	[illegible]
September 19	do	112	149	1.83	4.00	[illegible]
September 24	do	115	231	2.32	4.61	[illegible]
October 1	do	145	378	5.05	5.30	[illegible]
October 14	do	105	408	3.92	5.04	[illegible]
October 21	do	105	242	2.96	4.87	[illegible]
October 28	do	102	212	2.08	4.68	[illegible]
November 6	do	97	170	2.01	4.40	[illegible]
November 13	do	98	132	1.84	4.28	[illegible]
November 19	do	64	122	2.57	4.30	[illegible]
November 26	do	62	92	1.67	4.15	[illegible]
December 2	do	62	92	1.77	4.15	[illegible]
December 13	do	63	100	1.76	4.20	[illegible]

Mean daily gage height, in feet, of Animas River at Aztec, N. Mex., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.15	4.60	5.35	5.25	4.50	4.10
2	.....	4.15	4.35	5.20	4.95	4.55	4.10
3	.....	4.00	4.49	5.12	5.12	4.60	4.10
4	.....	4.00	4.60	5.00	5.52	4.52	4.25
5	.....	3.95	4.55	4.92	5.35	4.50	4.25
6	.....	3.92	4.42	4.85	7.50	4.45	4.20
7	.....	3.90	5.75	4.90	6.08	4.42	4.20
8	.....	3.80	4.98	4.75	7.40	4.38	4.20
9	.....	3.72	5.10	4.60	5.85	4.32	4.20
10	.....	3.68	5.05	4.48	7.40	4.30	4.20
11	.....	3.62	5.50	4.38	5.68	4.30	.....
12	.....	3.60	5.45	4.20	5.00	4.30	.....
13	.....	3.55	5.75	4.18	5.05	4.30	.....
14	.....	3.50	5.60	4.12	5.02	4.30	.....
15	.....	3.44	5.50	4.15	5.12	4.30	.....
16	.....	3.42	5.40	4.20	5.05	4.30	.....
17	.....	3.49	5.35	4.00	4.95	4.28	.....
18	.....	3.54	5.42	4.12	4.90	4.28	.....
19	.....	3.42	5.30	4.20	4.85	4.22	.....
20	.....	3.40	5.25	4.28	4.78	4.18	.....
21	4.60	3.38	5.08	4.45	4.88	4.25	.....
22	4.55	3.38	4.95	4.50	4.75	4.22	.....
23	4.60	3.34	5.02	4.85	4.85	4.28	.....
24	4.45	3.40	5.10	4.90	4.75	4.25	.....
25	4.45	3.60	5.15	4.72	4.72	4.28	.....
26	4.35	3.53	5.25	4.65	4.65	4.24	.....
27	4.25	3.48	5.05	4.80	4.62	4.20	.....
28	4.25	5.49	5.15	4.82	4.55	4.18	.....
29	4.20	3.56	5.25	4.95	4.58	4.10	.....
30	4.15	4.15	5.38	5.18	4.50	4.10	.....
31	.....	4.10	5.25	.....	4.48	.....	.....

Rating table for Animas River at Aztec, N. Mex., from June 19 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	120	3.80	255	4.60	640	5.60	1,860
3.35	130	3.85	270	4.70	720	5.70	2,020
3.40	140	3.90	290	4.80	810	5.80	2,180
3.45	152	3.95	310	4.90	910	5.90	2,340
3.50	166	4.00	330	5.00	1,020	6.00	2,500
3.55	180	4.10	370	5.10	1,140	6.10	2,660
3.60	195	4.20	410	5.20	1,270	6.20	2,820
3.65	210	4.30	460	5.30	1,400	6.30	2,980
3.70	225	4.40	510	5.40	1,540	6.40	3,140
3.75	240	4.50	570	5.50	1,700	6.50	3,300

The above table is based upon 22 discharge measurements made during 1904. Above gage height 5.40 feet the rating curve is a tangent, the difference being 160 per tenth. Owing to the shifting character of the stream bed this table was applied indirectly, according to the method outlined in the Nineteenth Annual Report, United States Geological Survey, Part IV, page 323 et seq.

Mean daily discharge, in feet, of Animas River at Aztec, N. Mex., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	410	765	1,270	1,860	390	152
2	.....	410	570	1,080	1,400	410	152
3	.....	350	640	1,020	1,620	435	152
4	.....	350	680	910	2,260	390	195
5	.....	310	605	810	2,900	390	195
6	.....	290	510	810	5,540	370	180
7	.....	290	1,940	860	3,300	350	180
8	.....	270	860	720	5,380	330	180
9	.....	255	910	640	2,980	290	166
10	.....	255	810	540	5,460	270	166
11	.....	225	1,270	485	2,740	270	166
12	.....	225	1,140	390	1,620	270	195
13	.....	195	1,470	390	1,780	255	166
14	.....	180	1,205	330	1,700	270	195
15	.....	168	1,020	350	1,780	270	.....
16	.....	152	860	370	1,540	290	.....
17	.....	166	860	290	1,270	290	.....
18	.....	180	910	310	1,080	310	.....
19	.....	140	860	350	910	270	.....
20	.....	140	810	390	720	255	.....
21	810	140	720	460	720	255	.....
22	765	140	605	485	605	225	.....
23	765	130	680	720	640	240	.....
24	640	140	765	765	540	210	.....
25	640	195	860	640	510	210	.....
26	570	180	965	680	460	570	.....
27	485	180	810	860	435	570	.....
28	485	180	910	910	390	570	.....
29	460	210	1,080	1,205	410	152	.....
30	435	435	1,270	1,620	370	152	.....
31	.....	410	1,080	.....	390	.....	.....

Estimated monthly discharge of Animas River at Aztec, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 21–30	810	435	606	12,020
July	435	130	235	14,450
August	1,940	510	917	56,380
September	1,620	290	689	41,000
October	5,540	370	1,720	105,800
November	570	152	318	18,920
December 1–14	195	152	174	4,830
The period				253,400

ANIMAS RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904, by M. C. Hinderlider. It is located at the highway bridge about 1 mile northeast of Farmington, N. Mex. A standard chain gage is attached to the downstream side of the bridge, 40 feet from the left end of the bridge. The gage scale is graduated to feet and tenths from 2 feet to 7.8 feet. The length of the chain from the end of the weight to the marker is 12.78 feet. The gage is read twice each day by Mrs. Adellie Ricketts, who lives near the west end of the bridge. Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the west face of the left abutment. It is marked "O" with black paint on the bridge floor, and the sounding points are similarly marked every 5 feet up to 195 feet. The channel is straight for about 900 feet above and below the station, and the current is moderate to swift. The right bank is a gradually sloping gravel bar, covered with small cobblestones and scattering trees and shrubs. It has been known to overflow, but this is an extremely rare occurrence. The left bank is a flat, grassy, perpendicular bank, 5 or 6 feet above low water, lined with willows, and is not subject to overflow. The bed of the stream is composed of gravel, cobblestones, and silt. It is free from vegetation and is permanent. The bench mark is a United States Geological Survey standard bench-mark tablet set into the southwest face of a 12-inch cottonwood tree about 50 feet north of the right end of the bridge. Its elevation is 11.13 feet above the datum of the gage and 3.17 feet below the top of the horizontal bridge chord on which the gage box rests.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of Animas River near Farmington, N. Mex.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis charg
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-f*
June 17	M. C. Hinderlider	132	321	2.39	5.49	7
July 2	R. C. Prewitt	117	200	1.50	4.82	2
July 9	do	109	155	.95	4.51	1
July 18	do	99	115	.38	4.17	
July 27	do	100	120	.51	4.22	
August 5	do	120	287	2.14	5.31	6
August 13	do	125	321	2.55	5.48	8
August 20	do	122	270	2.43	5.39	6
August 24	do	118	222	2.08	5.12	4
September 6	do	121	222	2.23	5.20	4
September 12	do	116	152	1.61	4.78	2
September 21	do	106	125	1.43	4.57	1
September 28	do	123	207	2.18	5.20	4
October 7	do	141	466	4.37	6.34	2,0
October 15	do	132	365	3.33	5.90	1,2
October 20	do	127	270	2.63	5.44	7
October 29	do	132	216	2.31	5.05	4
November 4	do	121	189	2.01	4.91	
November 17	do	120	136	1.73	4.57	2
November 28	do	80	102	1.42	4.35	1
December 5	do	81	108	1.47	4.38	1
December 12	do	81	106	1.45	4.34	1
December 22	do	80	95	1.38	4.24	1

Mean daily gage height, in feet, of Animas River near Farmington, N. Mex., for 1904.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.92	5.20	5.76	6.30	4.98	4.32
2	.....	4.82	5.16	5.84	6.08	4.94	4.32
3	.....	4.74	5.26	5.65	5.92	4.90	4.36
4	.....	4.72	5.34	5.46	5.82	4.86	4.46
5	.....	4.70	5.34	5.35	5.69	4.83	4.38
6	.....	4.64	5.16	5.23	5.72	4.80	4.32
7	.....	4.62	5.46	5.12	7.58	4.74	4.29
8	.....	4.50	5.23	5.04	7.44	4.73	4.26
9	.....	4.48	5.52	4.98	6.96	4.69	4.29
10	.....	4.48	5.34	4.90	6.48	4.68	4.31
11	.....	4.49	5.36	4.84	6.28	4.66	4.28
12	.....	4.32	5.60	4.74	6.14	4.59	4.32
13	.....	4.18	5.50	4.64	6.15	4.52	4.36
14	.....	4.06	5.54	4.69	6.00	4.56	4.31
15	.....	3.99	5.56	4.76	5.88	4.55	4.31
16	.....	3.95	5.51	4.62	5.85	4.54	4.36
17	.....	3.90	5.35	4.60	5.78	4.50	4.34
18	.....	4.14	5.65	4.58	5.66	4.50	4.34
19	.....	3.97	5.62	4.56	5.55	4.48	4.31
20	5.46	3.88	5.44	4.52	5.46	4.44	4.33
21	5.60	3.88	5.28	4.62	5.42	4.44	4.34
22	5.50	3.79	5.13	4.60	5.40	4.40	4.36
23	5.51	3.79	5.28	4.68	5.36	4.36	4.28
24	5.40	3.88	5.25	4.88	5.32	4.36	4.25
25	5.35	4.36	5.50	5.14	5.27	4.36	4.21
26	5.22	4.23	5.32	5.12	5.22	4.34	4.28
27	5.10	4.18	5.40	5.22	5.16	4.35	4.36
28	5.05	4.18	5.46	5.21	5.12	4.34	4.24
29	5.01	4.32	5.41	5.21	5.08	4.34	4.24
30	4.96	4.86	5.50	5.41	5.03	4.34	4.56
31	.....	5.12	5.88	.....	5.02	.....	4.47

Rating table for Animas River near Farmington, N. Mex., from June 20 to October 19, 19..

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.80	4	4.40	107	5.50	775	6.60	2,410
3.85	5	4.45	122	5.60	885	6.70	2,590
3.90	7	4.50	137	5.70	1,000	6.80	2,770
3.95	11	4.60	173	5.80	1,125	6.90	2,950
4.00	17	4.70	211	5.90	1,250	7.00	3,130
4.05	25	4.80	253	6.00	1,390	7.10	3,310
4.10	35	4.90	300	6.10	1,545	7.20	3,490
4.15	46	5.00	353	6.20	1,710	7.30	3,670
4.20	58	5.10	415	6.30	1,880	7.40	3,850
4.25	70	5.20	488	6.40	2,050	7.50	4,030
4.30	82	5.30	573	6.50	2,230	7.60	4,210
4.35	94	5.40	670				

The above table is based upon discharge measurements made prior to October 1904. It is fairly well defined between gage heights 4.20 feet and 6.00 feet. The table has been extended beyond these limits. Above gage height 6.40 feet the rating curve is a tangent, the difference being 180 per tenth.

Rating table for Animas River near Farmington, N. Mex., from October 20 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	125	4.50	208	4.80	337	5.10	510
4.25	137	4.55	225	4.85	363	5.20	580
4.30	150	4.60	243	4.90	390	5.30	655
4.35	163	4.65	263	4.95	420	5.40	735
4.40	177	4.70	287	5.00	450	5.50	825
4.45	192	4.75	311				

The above table is based upon 7 discharge measurements made after October 1904. It is well defined.

Estimated monthly discharge of Animas River near Farmington, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 20–30	885	332	588	12,830
July	430	4	112	6,888
August	1,225	437	687	42,240
September	1,175	144	414	24,640
October	4,174	462	1,301	80,000
November	438	160	245	14,580
December	229	127	158	9,715
The period				190,900

LA PLATA RIVER AT HESPERUS, COLO.

This station was established June 14, 1904, by M. C. Hinderlider, for the purpose of determining the water supply in La Plata River available for the La Plata project in New Mexico. It is located at the highway bridge on the west side of Hesperus, Colo. The gage consists of a 1 by 4 inch dressed-pine board 4 feet long, graduated to feet and tenths. The gage reads from zero to 3.9 feet, the zero resting on the bed of the river. The gage is spiked to the upstream end of the south face of the north abutment and is read twice each day by Hans Aspaas. Discharge measurements are made by wading at suitable points along the stream, as the conditions for careful gagings at the bridge are unfavorable. The initial point for soundings is a nail driven into the downstream side of the wagon bridge over the south face of the north abutment. The channel is straight for about 50 feet above and below the station, and the current is swift. Both banks are low, covered with brush and scattering trees, and are not subject to overflow. The bed of the stream is composed of large and small cobblestones and is permanent. There is a small island above the bridge and dead water at low stage and tortuous channel below the bridge, which would affect the accuracy of meter measurements at the bridge. The fall in La Plata River, according to levels run by the La Plata Ditch Company for about 10 miles, is 135 feet per mile. The bench mark is a nail, about 8 inches above the ground, on the right bank of the river, driven horizontally into the west face of a 12-inch cottonwood tree and about 75 feet northeast of the gage rod. Its elevation is 9.15 feet above the zero of the gage. This station was abandoned August 12, 1904.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

Discharge measurements of La Plata River at Hesperus, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 14	M. C. Hinderlider	24	20	0.90	1.98	18
July 12	G. B. Monk	22	17	.47	1.90	8
August 20	R. I. Meeker	24	26	1.50	2.30	39

Mean daily gage height, in feet, of La Plata River at Hesperus, Colo., for 1904.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	.....	1.88	2.38	12	.....	1.82	.....	22	1.92	1.82	.....
2	.....	1.88	2.42	13	.....	1.82	.....	23	1.85	1.80	.....
3	.....	1.88	2.32	14	.....	1.82	.....	24	1.82	1.85	.....
4	.....	1.90	2.25	15	1.94	1.82	.....	25	1.88	1.88	.....
5	.....	1.85	2.20	16	1.94	1.82	.....	26	1.85	1.88	.....
6	.....	1.88	2.20	17	1.96	1.78	.....	27	1.85	1.88	.....
7	.....	1.85	.....	18	1.90	1.80	.....	28	1.85	1.92	.....
8	.....	1.90	.....	19	1.85	1.80	.....	29	1.82	1.92	.....
9	.....	1.82	.....	20	1.85	1.82	.....	30	1.88	1.92	.....
10	.....	1.80	2.25	21	1.85	1.82	.....	31	.....	2.32	.....
11	.....	1.82	2.20								

MUDDY RIVER NEAR MOAPA, NEV.

This station was established January 1, 1904, by A. E. Chandler. It is located near the crossing of the San Pedro, Los Angeles and Salt Lake Railroad, about 6 miles downstream from Moapa, Nev. The station is above the Narrows, and will show the amount of water available for storage at the proposed reservoir sites in the Narrows. A vertical plain staff gage, graduated to feet and tenths, is nailed to a post driven into the right bank. It is read twice each day by J. V. Houghton. Discharge measurements are made from a footbridge 450 feet downstream from the gage. The initial point for soundings is a nail driven into the downstream side of the bridge at the right bank. The channel is straight for 35 feet above and below the station, and the velocity is moderate. The immediate banks are low, but not liable to overflow. High brush-covered banks slope up from the vertical sides of the channel. The bed of the stream is composed of sand and is shifting. It is covered with vegetation, which is kept grubbed out near the station. The bench mark is the top of a 2-inch circular post driven into the ground in a willow clump 20 feet from the gage on the right bank. Its elevation is 9.90 feet below the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Muddy River near Moapa, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 12	A. E. Chandler	11	34	1.24	2.10	42
June 11	H. H. Church	11	25	1.46	1.70	36
July 16	do	11	20	1.63	1.40	33
August 1	do	11	23	1.72	1.80	40
August 13	do	12	28	1.75	2.20	49
August 19	do	12	40	1.82	3.50	73
September 21	do	11	29	1.55	1.80	44
October 15	do	11	26	1.47	1.70	38
November 10	do	11	28	1.43	1.90	40
December 12	do	12	29	1.70	2.10	49

Mean daily gage height, in feet, of Muddy River near Moapa, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.20	2.98	2.60	2.48	2.02	2.02	1.60	1.90	1.80	1.80	1.90	2.00
2	3.20	2.98	2.60	2.48	2.02	2.02	1.60	1.70	1.80	1.80	1.90	2.00
3	3.20	2.98	2.60	2.48	2.02	2.02	1.70	1.85	1.80	1.80	1.90	2.00
4	3.18	3.00	2.60	2.48	2.02	2.02	1.65	1.70	1.80	1.80	1.90	2.00
5	3.15	2.98	2.60	2.48	2.02	2.02	1.60	1.70	1.80	1.70	1.90	2.00
6	3.15	2.98	2.60	2.48	2.02	2.02	1.65	1.70	1.80	1.60	1.90	2.00
7	3.15	2.98	2.60	2.48	2.02	2.02	1.60	1.70	1.80	1.60	1.90	2.00
8	3.15	2.98	2.60	2.48	2.02	2.02	1.60	1.70	1.80	1.60	1.90	2.00
9	3.10	2.98	2.50	2.48	2.02	2.02	1.55	1.70	1.80	1.60	1.90	2.00
10	3.10	2.98	2.50	2.48	2.02	2.02	1.50	2.00	1.80	1.60	1.90	2.00
11	3.10	2.98	2.50	2.48	2.02	2.02	1.50	3.50	1.80	1.60	1.90	2.10
12	3.10	2.98	2.50	2.48	2.02	1.80	1.50	4.00	2.65	1.60	1.90	2.10
13	3.10	2.95	2.50	2.48	2.02	1.80	1.50	2.22	9.50	1.60	1.90	2.10
14	3.10	2.95	2.50	2.25	2.02	1.80	1.50	2.20	6.50	1.60	1.90	2.10
15	3.05	2.90	2.50	2.25	2.02	1.80	1.50	2.25	3.00	1.60	1.90	2.10
16	3.05	2.90	2.50	2.25	2.02	1.80	1.50	2.30	1.80	1.60	1.90	2.10
17	3.10	2.80	2.48	2.25	2.02	1.80	1.50	2.40	1.80	1.60	1.90	2.10
18	3.10	2.80	2.48	2.25	2.02	1.80	1.50	3.00	1.80	1.60	1.90	2.10
19	3.10	2.80	2.48	2.02	2.02	1.80	1.60	4.25	1.80	1.60	1.90	2.20
20	3.10	2.80	2.48	2.02	2.02	1.80	1.60	5.00	1.80	1.60	1.90	2.20
21	3.08	2.68	2.48	2.02	2.02	1.80	1.60	1.80	1.80	1.60	1.90	2.20
22	3.05	2.68	2.48	2.02	2.02	1.80	1.75	2.25	1.80	1.60	1.90	2.20
23	3.08	2.68	2.48	2.02	2.02	1.80	1.65	2.75	1.80	1.60	2.00	2.20
24	3.08	2.62	2.48	2.02	2.02	1.80	1.80	3.00	1.80	1.60	2.00	2.20
25	3.05	2.60	2.48	2.02	2.02	1.80	1.80	5.00	1.80	1.60	2.00	2.20
26	3.05	2.60	2.48	2.02	2.02	1.80	1.80	2.50	1.80	1.60	2.00	2.20
27	3.02	2.60	2.48	2.02	2.02	1.80	1.85	2.50	1.80	1.80	2.00	2.20
28	3.02	2.60	2.48	2.02	2.02	1.80	1.90	3.50	1.80	1.80	2.00	2.20
29	3.02	2.60	2.48	2.02	2.02	1.80	1.95	2.00	1.80	1.90	2.00	2.20
30	3.00	.....	2.48	2.02	2.02	1.80	1.90	2.00	1.80	1.90	2.00	2.20
31	3.00	.....	2.48	.....	2.02	.....	2.50	1.80	.....	1.90	.....	2.20

GILA RIVER NEAR CLIFF, N. MEX.

This station was established September 9, 1904, by W. A. Farish. It is located one-half mile below the mouth of Mangos River and 40 miles from Silver City, N. Mex. The station is best reached by stage from Silver City to Gila Store, thence by private conveyance to the station. If the river is in flood, the latter part of the journey will have to be made horseback. A staff gage is fastened to a large cottonwood tree on the east side of the river. The gage is read twice each day by Mrs. Winnie P. Clark. Discharge measurements are made by means of a five-eighths-inch cable and car. The station is equipped with a tagged wire, marked every 5 feet. The initial point for soundings is the zero of the tagged wire. The channel is straight for 400 feet above and 300 feet below the station. The current is swift. Both banks are about 6 feet high, clean, and subject to overflow during extreme high water. The bed of the stream is composed of sand and gravel, free from vegetation, and shifting. There is but one channel at high and low stages. The channel, although straight, cuts across the section at a slight angle during low water. During freshets the channel will be at right angles to the measuring section. The bench mark is a point marked "U. S. G. S. B. M." with black paint in a blaze on a sycamore tree north 84° east 293 feet from the gage. Its elevation is 8.55 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Mean daily gage height, in feet, of Gila River near Cliff, N. Mex., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	2.32	0.87	1.10	17	1.90	1.00	1.10	1.0
2	.....	2.34	.90	1.10	18	1.82	1.00	1.10	1.0
3	.....	2.97	.90	1.16	19	1.79	1.00	1.10	1.0
4	.....	2.60	.92	1.02	20	1.73	1.02	1.10	1.0
5	.....	2.85	1.00	1.27	21	3.20	1.02	1.10	1.0
6	.....	2.70	1.00	1.10	22	2.20	1.00	1.05	1.0
7	.....	(a)	1.10	1.10	23	2.35	1.00	1.05	1.0
8	.....	.....	1.10	1.22	24	2.30	1.00	1.05	1.0
9	1.83	.....	1.10	1.47	25	2.32	1.00	1.05	1.0
10	1.79	.....	1.02	1.30	26	2.50	1.00	1.05	1.0
11	1.75	1.45	1.00	1.20	27	2.32	1.00	1.02	1.0
12	1.95	1.29	1.00	1.17	28	2.19	1.00	1.00	1.0
13	2.15	1.30	1.00	1.10	29	2.10	1.66	1.02	1.0
14	2.07	1.15	.97	1.10	30	2.32	1.02	1.08	.9
15	2.00	1.02	1.00	1.02	31	.....	.91	.....	.9
16	1.90	1.02	1.07	1.02					

a Gage destroyed by flood October 6; temporary gage put in October 11.

GILA RIVER AT SAN CARLOS, ARIZ.

The general character of the country through which the Gila River flows is a high and rolling plateau, with the river flowing through it in a deep canyon, and with practically no agricultural lands within its area. The river emerges from its upper canyon about 10 miles before it reaches the Arizona line, and thence flows through a valley of considerable width, known as Duncan Valley, until just before it receives the waters of San Francisco River.

Gila River is in a canyon for about 20 miles below the mouth of the San Francisco, or to within 10 miles of Solomonsville. At this point the hills separate, forming a large valley, which has been extensively settled and is now one of the finest irrigated portions of the Territory. This valley extends from a point 10 miles above Solomonsville to 6 miles below the mouth of San Carlos River, on the White Mountain Indian Reservation. At this latter place the mountains suddenly close in again and the river enters another canyon. Seven miles below the Indian agency at San Carlos the canyon narrows to a width of 100 feet, and at this point is located the San Carlos dam site, which was studied by the United States Geological Survey during 1899, in connection with the investigation of the water supply of Gila River. The results of this investigation are published in Water-Supply and Irrigation Paper No. 33, entitled "Storage of Water on Gila River, Arizona," by J. B. Lippincott. In connection with this investigation Cyrus C. Babb, on July 11, 1899, established a station on Gila River one-half mile south of the Indian agency at San Carlos and below the mouth of San Carlos Creek, where an inclined rod securely fastened to posts driven into the bank was erected. The original bench mark was a 20-penny nail in the base of a mesquite tree 5 inches in diameter, 85 feet west of the gage rod, at an elevation of 12.67 feet above gage datum. It was destroyed by a flood in the spring of 1903. A new bench mark was established May 9, 1903, by C. R. Olberg. It consists of a nail head in the west side of the post which supports the cable on the right bank of the river. Its elevation is 14.54 feet above the zero of the gage. The observer is R. H. Ross, who also makes the discharge measurements. Discharge measurements are made from a cable and car a short distance above the gage rod. The channel is straight for some distance above and below the station, and the water is comparatively swift. The right bank is high, but the left is low and liable to overflow. The bed of the stream is sandy and shifting.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Discharge measurements of Gila River at San Carlos, Ariz., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.	Ditch discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec. feet.*	
January 10	R. H. Ross	34	1.03	1.35	36	.....
January 17	do	31	1.11	1.35	34	.....
January 24	do	20	1.46	1.35	29	.....
January 30	do	20	1.48	1.35	30	.....
February 7	do	40	1.19	1.4	48	.....
February 14	do	30	.90	1.4	28	.....
February 21	do	32	.96	1.4	31	.....
February 28	do	20	1.00	1.3	20	.....
March 2	do	11	1.17	1.3	13	.....
March 2	do	10	1.01	1.3	10	4.9
March 10	do	10	.90	1.25	9.4	4.5
March 19	do	11	1.06	1.25	12	5.1
March 28	do	10	.91	1.25	9.5	4.7
April 4	do	11	.88	1.2	9.6	3.9
April 11	do	7.6	.96	1.15	7.4	3.2
April 21	do	4.4	.56	1.05	2.5	7.0
April 29	do	4.4	.52	1.05	2.3	6.5
May 7	do	2.8	.68	.0	1.9	6.0
May 12	do	32	1.34	1.3	43	.0
May 13	do	61	1.44	1.5	88	.0
May 20	do	0.0	.00	.0	0.0	2.5
July 21	do	67	2.43	1.7	163	.....
July 22	do	102	34.40	2.1	351	.....
July 23	do	117	3.86	2.2	452	.....
July 25	do	58	2.21	1.75	129	.....
July 26	do	137	1.79	1.95	246	.....
July 27	do	182	3.17	2.7	578	.....
July 28	do	166	2.65	2.4	441	.....
July 29	do	93	1.48	1.8	138	.....
July 30	do	255	7.05	3.5	1,801	.....
July 30	do	246	6.03	3.2	1,487	.....
July 31	do	180	3.21	2.5	578	.....
August 1	do	131	3.17	2.1	415	.....
August 2	do	176	2.91	2.6	511	.....
August 3	do	203	4.32	2.95	880	.....
August 4	do	153	3.10	2.45	475	.....
August 5	do	183	2.98	2.65	548	.....
August 5	do	331	7.57	4.1	2,511	.....
August 6	do	235	5.80	3.1	1,365	.....
August 6	do	331	7.54	4.15	2,500	.....

Discharge measurements of Gila River at San Carlos, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.	Ditch discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec. feet.*	
August 7	R. H. Ross	287	6.45	3.2	1,851	.....
August 8	....do	241	5.13	2.8	1,238	.....
August 9	....do	140	2.58	2.1	361	.....
August 10	....do	127	2.27	2.0	287	.....
August 11	....do	182	4.75	2.7	868	.....
August 13	....do	146	3.05	2.5	444	.....
August 14	....do	115	2.96	2.2	341	.....
August 16	....do	341	9.90	4.2	3,375	.....
August 17	....do	300	6.80	3.4	2,039	.....
August 18	....do	185	4.03	2.75	746	.....
August 19	....do	242	2.72	2.3	658	.....
August 20	....do	318	5.29	3.1	1,681	.....
August 21	....do	355	6.61	3.5	2,345	.....
August 25	....do	231	3.80	3.0	877	.....
August 25	....do	179	3.74	2.4	671	.....
August 26	....do	168	2.55	2.3	428	.....
August 28	....do	222	4.92	2.9	1,092	.....
August 29	....do	177	3.45	2.4	611	.....
September 4	....do	167	3.82	2.3	639	.....
September 5	....do	230	5.07	2.9	1,168	.....
September 6	....do	194	3.80	2.6	739	.....
September 8	....do	129	2.14	2.2	277	.....
September 11	....do	46	1.53	1.65	71	.....
September 12	....do	129	3.74	2.5	483	.....
September 14	....do	90	2.31	2.1	209	.....
September 16	....do	68	2.42	2.0	166	.....
September 18	....do	62	1.72	1.85	107	.....
September 23	....do	106	2.46	2.1	261	.....
September 28	....do	26	1.22	1.5	32	.....
October 6	....do	45	1.89	1.7	85	.....
October 8	....do	447	8.97	5.5	4,007	.....
October 9	....do	753	6.78	6.5	5,113	.....
October 10	....do	910	6.64	7.1	6,043	.....
October 12	....do	198	5.14	2.8	1,018	.....
October 14	....do	150	3.37	2.4	507	.....
October 16	....do	127	2.90	2.2	369	.....
October 18	....do	179	2.70	2.0	485	.....
October 20	....do	174	2.39	1.9	417	.....
October 22	....do	162	1.98	1.8	322	.....
October 2'	....do	103	1.77	1.6	182	.....

Discharge measurements of Gila River at San Carlos, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.	Ditch discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec. feet.*	
October 30	R. H. Ross	88	1.79	1.55	158	.....
November 6	do	81	1.80	1.55	147	.....
November 14	do	62	1.90	1.45	118	.....
November 21	do	55	1.38	1.35	77	.....
November 28	do	46	1.42	1.3	66	5.7
December 4	do	46	1.01	1.3	47	7.9
December 6	do	202	2.67	2.5	541	8.7

Mean daily gage height, in feet, of Gila River at San Carlos Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.35	1.30	1.25	1.05	(b)	(b)	1.90	2.18	1.45	1.65	1.25
2	1.35	1.35	1.30	1.25	1.05	(b)	(b)	2.60	1.90	1.45	1.65	1.25
3	1.35	1.35	1.30	1.20	1.05	(b)	(b)	3.02	1.95	1.45	1.60	1.25
4	1.35	1.35	1.30	1.20	1.05	(b)	(b)	2.25	2.85	1.45	1.60	1.30
5	1.35	1.35	1.30	1.20	1.05	(b)	(b)	3.28	2.88	1.45	1.58	1.30
6	1.35	1.38	1.30	1.20	1.02	(b)	(b)	3.60	2.50	1.65	1.55	2.45
7	1.35	1.40	1.30	1.20	(a)	(b)	(b)	3.50	2.15	3.75	1.55	2.25
8	1.35	1.40	1.28	1.20	(a)	(b)	(b)	2.60	1.85	5.60	1.55	2.10
9	1.35	1.40	1.25	1.15	(a)	(b)	(b)	2.05	1.70	6.60	1.50	2.10
10	1.35	1.40	1.25	1.15	(a)	(b)	(b)	2.60	1.70	7.05	1.50	2.20
11	1.35	1.40	1.25	1.15	(a)	(b)	(b)	2.65	1.65	3.85	1.50	2.20
12	1.35	1.40	1.25	1.10	1.50	(b)	(b)	2.58	2.08	2.75	1.48	2.20
13	1.35	1.40	1.25	1.10	1.60	(b)	(b)	2.35	2.40	2.55	1.45	2.10
14	1.35	1.40	1.25	1.05	1.20	(b)	(b)	2.20	2.05	2.38	1.45	1.90
15	1.35	1.40	1.25	1.05	1.10	(b)	(b)	1.95	1.90	2.28	1.42	1.90
16	1.35	1.40	1.25	1.05	1.00	(b)	(b)	3.35	2.10	2.20	1.40	1.85
17	1.35	1.40	1.25	1.05	(a)	(b)	(b)	3.25	2.00	2.25	1.40	1.80
18	1.35	1.40	1.25	1.05	(a)	(b)	(b)	2.68	1.82	2.00	1.40	1.80
19	1.35	1.40	1.25	1.05	(a)	(b)	(b)	2.15	1.75	1.90	1.40	1.80
20	1.35	1.40	1.25	1.05	(b)	(b)	(b)	2.80	1.62	1.90	1.35	1.75
21	1.35	1.40	1.25	1.05	(b)	(b)	1.50	3.50	1.60	1.90	1.35	1.75
22	1.35	1.40	1.25	1.05	(b)	(b)	1.95	2.90	1.55	1.80	1.35	1.70
23	1.35	1.40	1.25	1.05	(b)	(b)	2.20	4.10	2.05	1.80	1.32	1.70
24	1.35	1.40	1.25	1.05	(b)	(b)	2.10	2.95	1.75	1.80	1.35	1.65
25	1.35	1.40	1.25	1.05	(b)	(b)	1.95	2.35	1.70	1.70	1.30	1.62
26	1.35	1.40	1.25	1.05	(b)	(b)	1.80	2.15	1.60	1.60	1.30	1.60
27	1.35	1.35	1.25	1.05	(b)	(b)	2.05	2.10	1.50	1.60	1.30	1.60
28	1.35	1.30	1.25	1.05	(b)	(b)	2.30	2.50	1.50	1.60	1.30	1.60
29	1.35	1.30	1.25	1.05	(b)	(b)	1.70	2.50	1.50	1.60	1.30	1.60
30	1.35	.....	1.25	1.05	(b)	(b)	3.30	2.30	1.45	1.55	1.25	1.55
31	1.35	.....	1.25	.....	(b)	(b)	2.60	2.15	.....	1.55	.....	1.55

a No water at gage.

b River dry May 20 to July 20.

Mean daily discharge, in second-feet, of Gila River at San Carlos, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	27	31	15	12	2	(a)	(a)	250	440	20	210	38
2	28	31	12	12	2	(a)	(a)	511	220	20	210	35
3	29	31	12	9	2	(a)	(a)	940	270	20	180	31
4	30	32	12	10	2	(a)	(a)	330	1,300	20	175	47
5	31	32	12	10	2	(a)	(a)	1,400	1,168	20	165	45
6	32	40	12	10	2	(a)	(a)	1,900	640	70	147	500
7	33	48	12	10	2	(a)	(a)	2,300	320	1,040	150	400
8	34	45	9	10	2	(a)	(a)	960	120	4,130	150	500
9	35	42	9	7	2	(a)	(a)	320	75	5,330	130	550
10	36	39	9	7	1	(a)	(a)	960	80	5,870	130	660
11	36	37	9	7	1	(a)	(a)	810	71	1,540	135	660
12	35	34	9	5	88	(a)	(a)	630	215	970	120	660
13	35	31	10	5	115	(a)	(a)	340	400	710	115	575
14	35	28	10	4	26	(a)	(a)	341	185	507	118	400
15	35	29	11	4	12	(a)	(a)	240	130	420	106	400
16	34	29	11	4	3	(a)	(a)	2,040	210	369	93	365
17	34	29	12	3	2	(a)	(a)	1,810	165	545	94	330
18	33	30	12	3	2	(a)	(a)	680	95	485	95	330
19	32	30	12	3	1	(a)	(a)	490	85	410	96	330
20	32	31	12	3	(a)	(a)	(a)	1,230	60	417	77	290
21	31	31	12	2	(a)	(a)	65	2,345	60	400	77	290
22	31	32	11	2	(a)	(a)	230	1,000	50	322	80	260
23	30	33	11	2	(a)	(a)	452	3,200	230	320	70	260
24	29	35	11	2	(a)	(a)	360	1,100	100	320	80	225
25	29	36	11	2	(a)	(a)	260	490	85	245	60	210
26	29	37	10	2	(a)	(a)	150	300	55	185	62	195
27	29	27	10	2	(a)	(a)	235	300	32	182	64	195
28	30	20	10	2	(a)	(a)	350	660	32	180	66	195
29	30	17	10	2	(a)	(a)	90	730	32	180	62	195
30	30	.....	11	2	(a)	(a)	1,580	530	20	158	42	165
31	30	.....	11	.....	(a)	.....	670	390	.....	155	.....	165

a River dry.

Estimated monthly discharge of Gila River at San Carlos, Ariz., for 1904.

[Drainage area 13,460 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches
January	36	27	31.7	1,949	0.0024	0.0
February	48	17	32.6	1,875	.0024	.0
March	15	9	11.0	676	.00082	.0
April	12	2	5.3	315	.00039	.0
May	115	0	8.7	535	.00065	.0
June	0	0	0	0	0.000	0.0
July	1,580	0	143	8,793	.011	.013
August	3,200	240	952	58,540	.071	.082
September	1,300	20	232	13,800	.017	.019
October	5,870	20	825	50,730	.061	.070
November	210	42	112	6,664	.0083	.0
December	660	31	306	18,820	.023	.0
The year	5,870	0	222	162,700	.0165	.2

NOTE.—The above estimates have been prepared by interpolation based upon the discharge measurements and gage heights owing to the shifting character of the bed.

GILA RIVER NEAR GILA CITY, ARIZ.

On October 15, 1903, a station was established near Gila City, Ariz., by W. D. Smith. The station is located one-fourth mile north of Gila City, and 14 miles east of Yuma, Ariz. The gage is a 4 by 4 inch vertical post buried 6 feet in the ground on the left bank of the river. It is read twice each day by O. F. Thornton. Discharge measurements are made by means of a boat and cable. The initial point for soundings is an iron stake driven to the surface of the ground on the left bank 7.7 feet from the gage. The channel is straight for 100 feet above and 900 feet below the station. Velocity is swift. The right bank is low and not subject to overflow. The left bank is above high water. The bed of the stream is composed of silt and sand and is subject to continual change. The bench mark is a standard United States Geological Survey bronze cap, located at the Southern Pacific railway depot, at Gila City, and has an elevation of 189.60 feet above sea level. Its elevation above the zero of the gage is 31.98 feet.

The observations at this station during 1904 have been made under the direction of S. G. Bennett and W. B. Clapp, district hydrographers.

Discharge measurements of Gila River near Gila City, Ariz., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
August 1	W. D. Smith	5.90	1,433
August 15	do	5.15	718
September 8	S. M. Smith	5.70	900
September 16	do	4.80	543
September 27	W. D. Smith	3.10	164
October 13	do	7.35	2,379
October 14	do	7.65	2,595

Mean daily gage height, in feet, of Gila River near Gila City, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	.....	.....	.....	.....	6.10	7.50	2.80	3.90	.....
2	.....	.....	.....	.....	.....	.....	.....	6.55	(a)	2.75	3.80	.....
3	.....	.....	.....	.....	.....	.....	.....	6.90	.....	2.65	3.80	.....
4	.....	.....	.....	.....	.....	.....	.....	7.00	.....	2.65	3.70	.....
5	.....	.....	.....	.....	.....	.....	.....	7.50	.....	2.60	3.70	.....
6	.....	.....	.....	.....	.....	.....	.....	8.35	.....	2.60	3.60	.....
7	.....	.....	.....	.....	.....	.....	.....	5.55	.....	2.60	3.60	.....
8	.....	.....	.....	.....	.....	.....	.....	5.50	5.70	2.60	3.60	.....
9	.....	.....	.....	.....	.....	.....	.....	7.50	5.20	2.50	3.50	.....
10	.....	.....	.....	.....	.....	.....	.....	7.75	4.90	2.50	3.50	.....
11	.....	.....	.....	.....	.....	.....	.....	6.80	4.70	2.50	3.50	.....
12	.....	.....	.....	.....	.....	.....	.....	7.20	4.50	6.60	3.45	.....
13	.....	.....	.....	.....	.....	.....	.....	7.55	4.25	7.20	3.45	.....
14	.....	.....	.....	.....	.....	.....	.....	6.35	3.95	7.70	3.45	.....
15	.....	.....	.....	.....	.....	.....	.....	5.15	5.70	7.05	3.40	.....
16	.....	.....	.....	.....	.....	.....	.....	4.00	4.70	5.70	3.40	.....
17	.....	.....	.....	.....	.....	.....	.....	4.95	4.70	4.90	3.30	.....
18	.....	.....	.....	.....	.....	.....	.....	5.65	4.20	4.55	3.20	.....
19	.....	.....	.....	.....	.....	.....	.....	6.40	4.00	4.45	3.10	.....
20	.....	.....	.....	.....	.....	.....	.....	7.30	4.00	4.90	3.00	.....
21	.....	.....	.....	.....	.....	.....	.....	7.70	3.70	4.95	2.90	.....
22	.....	.....	.....	.....	.....	.....	.....	8.05	3.50	4.85	2.90	.....
23	.....	.....	.....	.....	.....	.....	.....	8.15	3.45	4.70	2.90	.....
24	.....	.....	.....	.....	.....	.....	.....	7.90	3.25	4.65	2.90	.....
25	.....	.....	.....	.....	.....	.....	.....	7.95	3.15	4.50	2.90	.....
26	.....	.....	.....	.....	.....	.....	.....	8.05	2.90	4.40	2.90	.....
27	.....	.....	.....	.....	.....	.....	.....	8.20	3.05	4.25	.....	.....
28	.....	.....	.....	.....	.....	.....	.....	8.45	2.95	4.20	.....	.....
29	.....	.....	.....	.....	.....	.....	.....	9.20	2.85	4.10	.....	.....
30	.....	.....	.....	.....	.....	.....	6.00	9.65	2.85	4.00	.....	.....
31	.....	.....	.....	.....	.....	.....	6.50	8.10	.....	3.90	.....	.....

a Gage washed out; replaced Sept. 8.

NOTE.—River dry from January 1 to July 29, inclusive, and from November 27 to December 31, inclusive.

Estimated monthly discharge of Gila River near Gila City, Ariz., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			0.0	0
February			0.0	0
March			0.0	0
April			0.0	0
May			0.0	0
June			0.0	
July	1,650	0	94.2	5,7[illegible]
August	4,560	940	2,270	139,6[illegible]
September	2,490	50	700	41,7[illegible]
October	2,670	10	534	32,8[illegible]
November	260	0	109	6,4[illegible]
December	0	0	0.0	0
The period	4,560	0	312	226,4[illegible]

SAN FRANCISCO RIVER AT ALMA, N. MEX.

This station was established October 18, 1904, by W. A. Farish. It is located about one-half mile southwest of Alma, N. Mex., and 85 miles northwest of Silver City, N. Mex. It is best reached by stage from Silver City, which makes trips daily except Sundays. A staff gage is fastened to the east or left bank of the stream. The station is equipped with a one-half inch cable and tagged wire, with tags 5 feet apart. The initial point for soundings is the zero of the tagged wire. The channel is straight for about 500 feet above and below the station. The current is swift. Both banks are about 4 feet high, clean, and subject to overflow during extreme high water. The bed of the stream is composed of gravel, free from vegetation, firm, and regular. The bench mark is a 20-penny nail driven into a cottonwood tree, marked "U. S. G. S. B. M." in a blaze north 73° east 118.5 feet from the gage. Its elevation is 9.06 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. A. Farish, district hydrographer.

Discharge measurements on San Francisco River at Alma, N. Mex., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
August 19	W. A. Farish	1.85	[illegible]
August 19	do	2.40	[illegible]
August 21	do	3.00	[illegible]
September 1	do	4.00	[illegible]
October 9	do	2.05	[illegible]

NOTE—These measurements were all made by floats.

Mean daily gage height, in feet, of San Francisco River, at Alma, N. Mex., for 1904.

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.77	.....	1.45	1.4	17	.....	.....	1.4	1.4	1.35
2	.....	1.52	.....	1.45	1.4	18	2.10	.....	1.4	1.4	1.35
3	.....	1.47	.....	1.45	2.4	19	2.10	.....	1.4	1.4	1.35
4	.....	1.62	5.0	1.45	1.9	20	1.62	.....	1.4	1.4	1.4
5	.....	2.57	1.8	1.45	1.85	21	2.02	.....	1.4	1.4	1.4
6	.....	(a)	1.45	1.4	1.45	22	2.02	.....	1.4	1.4	1.4
7	.....	.....	1.5	1.4	1.5	23	3.07	.....	1.4	1.37	1.36
8	.....	.....	4.15	1.4	1.7	24	3.30	.....	1.4	1.37	1.36
9	.....	.....	2.2	1.4	1.45	25	1.97	.....	1.4	1.4	1.37
10	.....	.....	1.42	1.4	1.4	26	1.85	.....	1.4	1.4	1.4
11	.....	.....	1.42	1.4	1.4	27	1.97	.....	1.4	1.4	1.4
12	.....	.....	1.4	1.4	1.4	28	1.95	.....	1.4	1.4	1.4
13	.....	.....	1.45	1.4	1.4	29	1.80	.....	1.45	1.4	1.4
14	.....	.....	1.4	1.4	1.4	30	1.57	.....	1.45	1.4	1.4
15	.....	.....	1.4	1.4	1.35	31	1.52	.....	1.45	.....	1.4
16	.....	.....	1.4	1.4	1.35						

(a) September 6 to October 3, inclusive, the gage height was approximately 1.1. A bar formed making the gage useless.

Mean daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	470	10	55	.....	17	.....	10	47	45	.....
2	.....	60	10	55	.....	18	150	10	47	45	.....
3	.....	60	10	55	.....	19	150	10	47	.....	.....
4	.....	68	2,000	55	.....	20	70	10	47	.....	.....
5	.....	350	100	55	.....	21	135	10	47	.....	.....
6	.....	48	50	45	.....	22	135	10	47	.....	.....
7	.....	10	60	45	.....	23	690	10	47	.....	.....
8	.....	10	270	45	.....	24	195	10	47	.....	.....
9	.....	10	170	45	.....	25	128	10	47	.....	.....
10	.....	10	230	45	.....	26	110	10	47	.....	.....
11	.....	10	230	45	.....	27	128	10	47	.....	.....
12	.....	10	225	45	.....	28	128	10	47	.....	.....
13	.....	10	50	45	.....	29	100	10	55	.....	.....
14	.....	10	47	45	.....	30	70	10	55	.....	.....
15	.....	10	47	45	.....	31	60	.....	55	.....	.....
16	.....	10	47	45	.....						

NOTE.—The above is based on the float measurements and is approximate only.

Estimated monthly discharge of San Francisco River at Alma, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
August 18–31	690	60	161	4,470
September	470	10	43.2	2,571
October	2,000	10	138	8,485
November 1–18	55	45	47.8	1,708

SAN PEDRO RIVER AT CHARLESTON, ARIZ.

This station was established January 22, 1904, by H. R. Evans. It is located about one-half mile west of Charleston station on the El Paso and Southwestern Railroad, and 6 miles south of Fairbank, Ariz. The original gage was read until March 28. From March 29 to July 30 readings were from a second gage established March 24, 200 feet upstream from the first gage. The second gage is composed of two sections. The upper section is attached vertically to a cottonwood tree on the left bank and the lower part is inclined, having its upper end fastened to the same tree and the lower end set in the bed of the stream. The July and August floods changed the channel so that a third gage was necessary. This was established August 15, directly opposite the old or second gage, on the east bank, and consisted of a vertical rod fastened to a deadman in the bank at the same datum as the old gage. Readings were made from the third gage for the remainder of the year. The gage is read twice each day by H. R. Fry, who also makes the discharge measurements. Discharge measurements are made by means of a cable and car 10 feet below the gage during high water and by wading during low water. The initial point for soundings is 21 feet from the cable support on the east bank. Sounding points are indicated by means of a tagged line marked every 10 feet. The channel is straight for about 300 feet above and 500 feet below the station, and the current is swift. Both banks are nearly vertical for 20 feet, clean, and do not overflow. The bed of the stream is composed of sand and is shifting. At high water there is but one channel and at low water it is divided by sand bars. Bench mark No. 1 is a United States Geological Survey standard iron bench-mark post near a post on the east side of the El Paso and Southwestern Railroad station at Charleston. Its elevation is 57.265 feet above the zero of the gage and 3,957.265 feet above mean sea level. Bench mark No. 2 is a spike in the west side of the root of a tree on the west bank of the river, 100 feet above the gage. Its elevation is 35.860 feet above the zero of the gage and 3,935.860 feet above mean sea level.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Discharge measurements on San Pedro River at Charleston, Ariz., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 20	H. R. Fry	28	0.94	28.78	26
April 27	do	27	.85	28.8	23
May 4	do	20	.94	28.82	19
May 11	do	38	1.56	29.3	59
May 18	do	32	.98	28.95	31
May 25	do	46	1.21	29.05	56
June 1	do	11	.89	28.7	10
June 18	do	14	1.02	28.75	14
June 22	do	13	.66	28.75	9
June 29	do	19	.70	28.7	14
July 6	do	18	.64	28.7	12
July 13	do	16	.72	28.65	11
July 15	do	59	2.51	29.67	148
July 20	do	51	1.27	29.05	64
July 22	do	131	3.40	29.92	445
July 23[a]	do	258	8.45	32.6	2,180
July 23[a]	do	310	8.07	33.3	2,502
July 23[a]	do	157	4.03	31.1	633
July 26[a]	do	544	9.23	36.2	5,026
July 27[a]	do	573	9.30	36.5	5,326
July 30[a]	do	788	12.16	38.6	9,566
August 17[a]	do	187	2.81	28.3	524
August 20[a]	do	451	5.97	31.5	2,694
August 21[a]	do	310	5.41	29.8	1,678
August 29	do	34	2.09	26.2	72
September 8[b]	do	41	1.95	25.8	80
September 13[a]	do	131	2.58	27.6	338
September 14	do	49	2.49	26.6	122
September 22[b]	do	34	1.65	26.2	57
September 30	do	27	1.64	26.0	45
September 30[b]	do	23	1.92	26.0	44
October 6	do	29	1.52	26.2	44
October 12	do	26	1.60	25.95	42
October 19	do	24	1.63	25.8	39
October 24[a]	do	162	3.00	28.0	484
November 9	do	19	1.53	26.2	29
November 16	do	20	1.56	26.15	32
November 23	do	19	1.62	26.05	31

[a] Measurement made by floats. [b] Measurement made above station.

Discharge measurements on San Pedro River at Charleston, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
November 30	H. R. Fry	19	1.61	26.0	
December 7	do	20	1.64	26.15	
December 14	do	21	1.60	26.05	
December 21	do	18	1.63	26.15	
December 28	do	23	1.54	26.15	

Mean daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	28.50	28.45	28.80	28.78	28.70	28.75	30.15	27.40	26.00	26.30	
2	.....	28.50	28.45	28.80	28.78	28.70	28.68	29.15	26.65	26.05	26.30	
3	.....	28.50	28.45	28.78	28.78	28.70	28.65	29.55	26.35	26.35	26.22	
4	.....	28.52	28.40	28.80	28.82	28.78	28.65	29.30	26.35	26.20	26.30	
5	.....	28.51	28.35	28.75	28.80	28.75	28.65	29.10	26.05	26.10	26.28	
6	.....	28.50	28.35	28.78	28.75	28.78	28.70	28.75	25.85	26.20	26.25	
7	.....	28.50	28.35	28.80	28.72	28.75	28.70	28.50	25.82	26.15	26.25	
8	.....	28.50	28.35	28.80	28.78	28.80	28.70	29.50	25.80	26.20	26.20	
9	.....	28.48	28.30	28.80	28.78	28.72	28.65	27.95	25.80	26.20	26.20	
10	.....	28.48	28.28	28.82	28.78	28.68	28.62	28.35	25.90	26.17	26.20	
11	.....	28.44	28.28	28.82	29.65	28.72	28.65	28.00	25.80	25.98	26.20	
12	.....	28.48	28.35	28.80	29.42	28.78	28.62	.....	25.50	25.95	26.15	
13	.....	28.48	28.40	28.82	29.12	28.75	28.62	.....	27.30	26.00	26.15	
14	.....	28.46	28.38	28.82	29.08	28.78	28.62	.....	26.65	25.98	26.15	
15	.....	28.49	28.40	28.78	29.00	28.78	29.58	26.60	26.35	25.90	26.15	
16	.....	28.43	28.40	28.72	29.00	28.80	29.75	30.95	26.60	25.92	26.15	
17	.....	28.66	[a]28.60	28.72	28.92	28.75	[c]29.35	28.25	26.20	25.92	26.15	
18	.....	28.47	28.50	28.72	28.92	28.72	29.60	[g]28.20	26.05	25.90	26.12	
19	.....	28.50	28.48	28.78	28.85	28.75	29.85	28.10	26.10	25.80	26.10	
20	.....	28.45	28.45	28.78	28.80	28.75	[d]29.28	30.15	26.00	25.80	26.10	
21	.....	.....	28.40	28.78	28.82	28.75	[e]29.05	28.55	25.92	25.80	26.10	
22	.....	.....	28.42	28.78	28.80	28.72	30.40	27.80	26.15	25.85	26.10	
23	.....	.....	28.42	28.75	28.80	28.72	[f]31.85	27.60	26.20	25.80	26.05	
24	.....	.....	28.45	28.78	28.78	28.72	29.60	[h]28.65	26.20	27.30	26.05	
25	.....	.....	28.50	28.78	29.05	28.72	30.25	26.90	26.10	26.22	26.05	
26	.....	.....	28.52	28.78	28.98	28.72	33.70	27.00	26.05	26.22	26.05	
27	28.40	.....	28.55	28.80	28.85	28.72	34.25	26.50	26.00	26.32	26.05	
28	28.30	28.50	[b]28.52	28.78	28.80	28.78	29.20	26.20	25.95	26.30	26.00	
29	28.82	28.50	28.80	28.78	28.78	28.72	30.20	26.20	25.93	26.30	26.00	
30	.....	.....	28.75	28.78	28.75	28.75	41.25	26.35	26.00	26.25	26.00	
31	.....	.....	28.80	.....	28.72	.....	32.40	26.70	.....	26.25	.....	

[a] Dam above washed out. Water rose to 30-foot gage height during the night.
[b] New gage installed March 28, 1904.
[c] Gage 30.2 feet during night of July 17.
[d] Gage 31.0 feet during night of July 20.
[e] Gage 34.0 feet during night of July 21.
[f] Gage 33.3 feet at noon of July 23.
[g] Gage 30.1 feet during night of August 18.
[h] Gage 31.4 feet at 9 a. m. and 32.3 at 12 m. on August 24.

NOTE.—January 27 to March 28 from gage No. 1; March 29 to August 11 from gage No. 2; Aug[illegible] to December 31 from gage No. 3.

Mean daily discharge, in second-feet, of San Pedro River at Charleston, Ariz., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	22	20	12	17	1,730	320	41	36	28
2	.....	22	20	10	11	1,080	180	42	36	29
3	.....	20	20	10	8	1,330	130	69	30	30
4	.....	22	19	17	8	1,175	137	50	36	27
5	.....	17	16	14	8	1,050	95	38	34	24
6	.....	20	13	17	12	950	74	44	32	23
7	.....	22	10	14	12	820	77	43	32	24
8	.....	22	15	19	12	1,300	80	50	29	29
9	.....	22	15	11	9	555	66	54	29	26
10	.....	24	15	9	7	740	66	55	29	28
11	.....	24	112	11	10	575	45	40	29	30
12	.....	22	78	17	8	.....	20	42	30	32
13	.....	24	41	14	9	.....	265	46	32	35
14	.....	24	38	15	9	.....	130	47	32	34
15	.....	20	31	15	132	100	82	42	32	32
16	.....	14	33	17	166	2,330	120	45	32	34
17	.....	14	26	11	102	510	62	47	32	32
18	.....	15	28	9	148	490	46	46	31	31
19	.....	26	23	10	200	470	50	39	31	30
20	.....	26	20	10	100	1,660	40	39	32	28
21	.....	26	22	10	100	890	33	39	33	29
22	.....	26	22	6	690	500	52	43	34	30
23	.....	21	24	8	1,400	425	57	39	31	27
24	.....	23	23	9	100	900	59	260	31	28
25	.....	22	56	10	325	220	50	30	31	29
26	.....	22	46	11	2,750	240	46	30	31	26
27	.....	23	30	13	3,250	125	42	38	31	31
28	.....	20	24	20	500	75	39	36	30	35
29	22	20	20	16	1,500	72	38	36	30	36
30	17	20	17	18	12,000	98	45	32	30	34
31	22	.....	13	.....	3,550	170	.....	32	.....	38

Estimated monthly discharge of San Pedro River at Charleston, Ariz., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 29–31	22	17	20.3	121
April	26	14	21.5	1,279
May	112	10	28.7	1,765
June	20	6	12.8	762
July	12,000	7	876	58,860
August 1–11 and 15–31	2,330	72	735	40,820
September	320	20	84.9	5,052
October	260	30	49.5	3,044
November	36	29	31.6	1,880
December	38	23	30.0	1,845
The period	.....	.....	.....	110,400

NOTE.—The above estimates have been prepared by interpolation based upon the discharge measurements and gage heights.

SALT RIVER AT ROOSEVELT, ARIZ.

This station, established February 7, 1901, by H. G. Heisler, is located at the town of Roosevelt, which is the United States Geological Survey construction camp for the Salt River dam and reservoir, and is about 12 miles west of Livingston. In reports previous to 1903 this station was called Salt River, at reservoir site below Tonto Creek, near Livingston, Ariz.

The gage rod and cable are at the upper end of the gorge, about 2,000 feet below the mouth of Tonto Creek and 1,500 feet above the dam site. The gage is a vertical rod fastened to the rocks on the left bank of the river. Gagings are made from a car and cable.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
January 2	O. Richins	111	2.01	7.18	[illegible]
February 29	do	112	1.94	7.19	[illegible]
March 15	do	118	1.93	7.20	[illegible]
March 20	do	115	1.87	7.17	[illegible]
March 31	do	112	1.74	7.16	[illegible]
April 9[a]	do	86	1.78	7.15	[illegible]
April 16[a]	do	88	1.63	7.10	[illegible]
May 9[a]	do	74	1.66	7.05	[illegible]
May 10	do	176	2.62	7.80	[illegible]
May 21	do	74	1.67	7.06	[illegible]
May 28	do	68	1.68	7.00	[illegible]
June 4	do	60	1.54	6.97	[illegible]
June 18	do	53	1.44	6.92	[illegible]
June 28	do	50	1.31	6.88	[illegible]
July 16	do	46	1.13	6.80	[illegible]
July 23[b]	do	270	3.23	8.45	[illegible]
July 25[b]	do	455	5.43	9.40	[illegible]
July 26[b]	do	1,598	10.00	15.30	[illegible]
August 4[b]	do	405	4.45	8.90	[illegible]
August 16[b]	do	418	4.41	9.05	[illegible]
August 17[b]	do	851	7.70	13.30	[illegible]
August 23[b]	do	709	9.00	12.70	[illegible]
August 23[b]	do	1,687	11.00	15.90	[illegible]
August 23[b]	Hill and Richins	1,935	12.00	17.40	[illegible]
August 30[b]	O. Richins	500	6.00	9.50	[illegible]
September 26	do	105	1.56	6.95	[illegible]

[a] Measurement made below regular station. [b] Measurement made by floats.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
October 7	O. Richins	241	2.62	7.87	632
October 13	do	231	2.22	7.74	514
October 21	do	157	1.48	7.10	232
October 28	do	135	1.44	6.96	195
November 4	do	140	1.28	6.95	178
November 18	do	133	1.24	6.91	164
November 26	do	132	1.24	6.91	164
December 2	do	135	1.25	6.91	169
December 9	do	144	1.47	7.04	211
December 23	do	135	1.28	6.95	174

Mean daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.18	7.18	7.18	7.17	7.05	6.99	6.87	8.02	7.72	6.93	6.93	6.91
2	7.18	7.18	7.18	7.17	7.05	6.98	6.86	7.90	7.65	6.92	6.93	6.91
3	7.18	7.18	7.18	7.16	7.05	6.97	6.85	8.05	7.60	6.92	6.93	6.91
4	7.18	7.18	7.19	7.16	7.05	6.97	6.84	8.85	7.52	6.91	6.92	6.92
5	7.18	7.18	7.19	7.16	7.05	6.97	6.83	8.30	7.48	6.90	6.92	6.92
6	7.18	7.20	7.19	7.16	7.05	6.96	6.82	7.70	7.45	6.90	6.92	6.93
7	7.18	7.19	7.19	7.16	7.05	6.96	6.82	7.75	7.45	7.77	6.92	6.96
8	7.18	7.19	7.19	7.15	7.05	6.96	6.82	7.90	7.40	7.85	6.92	7.09
9	7.18	7.18	7.19	7.15	7.04	6.94	6.81	7.72	7.40	7.35	6.92	7.05
10	7.18	7.18	7.19	7.14	7.47	6.94	6.81	8.42	7.40	7.25	6.92	7.00
11	7.18	7.18	7.19	7.14	7.10	6.94	6.81	7.90	7.40	7.25	6.92	6.97
12	7.18	7.18	7.20	7.13	7.20	6.94	6.80	7.65	[c]7.40	7.95	6.92	6.95
13	7.18	7.18	7.20	7.12	7.15	6.93	6.80	7.60	8.13	7.85	6.91	6.95
14	7.18	7.18	7.20	7.11	7.13	6.93	6.80	7.92	7.82	7.74	6.91	6.95
15	7.18	7.18	7.20	7.11	7.12	6.93	6.80	8.45	8.85	7.60	6.90	6.94
16	7.18	7.18	7.20	7.10	7.10	6.92	6.80	8.65	8.10	7.51	6.90	6.94
17	7.18	7.18	7.20	7.10	7.09	6.92	6.80	10.00	8.00	7.41	6.90	6.94
18	7.18	7.18	7.20	7.09	7.07	6.92	6.80	9.50	7.74	7.26	6.90	6.94
19	7.18	7.18	7.20	7.09	7.06	6.91	6.80	8.60	7.40	7.12	6.90	6.93
20	7.18	7.18	7.19	7.08	7.06	6.91	6.82	8.55	7.07	7.07	6.90	6.93
21	7.18	7.18	7.19	7.08	7.06	6.91	6.81	7.90	7.00	7.05	6.90	6.93
22	7.18	7.18	7.18	7.08	7.05	6.90	8.80	[b]14.50	6.98	7.03	6.90	6.93
23	7.18	7.18	7.18	7.07	7.01	6.90	7.80	9.80	6.98	7.00	6.91	6.95
24	7.18	7.18	7.17	7.07	7.03	6.90	7.00	8.75	6.97	7.00	6.91	6.93
25	7.18	7.18	7.17	7.07	7.02	6.88	8.32	8.37	6.96	6.97	6.91	6.93
26	7.18	7.18	7.17	7.06	7.01	6.88	[a]8.10	8.05	6.95	6.96	6.90	6.92
27	7.18	7.18	7.17	7.06	7.01	6.88	8.30	7.85	6.95	6.96	6.90	6.91
28	7.18	7.18	7.17	7.05	7.00	6.88	8.38	8.05	6.95	6.96	6.90	6.91
29	7.18	7.18	7.17	7.05	7.00	6.88	8.25	7.90	6.94	6.95	6.90	6.91
30	7.18	.....	7.16	7.05	6.99	6.87	9.15	7.85	6.93	6.95	6.90	6.91
31	7.18	.....	7.16	.....	6.99	.....	8.35	7.80	.....	6.95	.....	6.91

[a] On the night of July 26, gage read 11.3 feet.
[b] At 3 p. m., August 22, gage read 17.5 feet.
[c] On the night of September 12, gage read 11.3 feet.

Mean daily discharge, in second-feet, of Salt River at Roosevelt, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	223	217	212	195	124	105	64	675	600	158	175	[illegible]
2	224	217	212	191	123	100	62	590	540	154	173	[illegible]
3	224	217	213	182	123	95	60	720	520	154	171	[illegible]
4	224	217	219	178	123	93	58	1,615	460	150	166	[illegible]
5	224	216	219	174	122	93	56	960	435	146	166	[illegible]
6	223	224	219	170	122	90	54	445	415	146	166	[illegible]
7	223	220	220	166	122	90	54	480	415	555	166	[illegible]
8	223	220	220	158	122	87	54	590	385	610	166	[illegible]
9	223	215	221	153	118	84	52	445	385	285	166	[illegible]
10	222	215	221	150	296	84	52	1,065	385	235	166	[illegible]
11	222	215	221	152	140	83	52	590	385	230	166	[illegible]
12	222	215	226	149	178	83	50	410	385	690	166	[illegible]
13	222	214	227	146	158	80	50	380	1,020	595	163	[illegible]
14	222	214	227	145	150	80	51	590	700	530	163	[illegible]
15	221	214	228	146	146	80	52	1,120	1,970	450	160	[illegible]
16	221	214	228	143	139	77	52	1,355	990	400	160	[illegible]
17	221	213	228	143	136	76	52	3,600	880	350	160	[illegible]
18	221	213	229	139	128	76	52	2,645	630	280	160	[illegible]
19	220	213	229	139	124	74	52	1,295	385	220	160	[illegible]
20	220	213	225	136	124	74	57	1,235	215	210	160	[illegible]
21	220	213	224	136	124	74	55	590	186	211	160	[illegible]
22	220	212	218	136	122	71	1,550	14,700	178	207	160	[illegible]
23	219	212	217	132	120	71	515	3,200	178	198	164	[illegible]
24	219	212	210	132	119	71	105	1,500	174	201	164	[illegible]
25	219	212	209	131	117	66	960	1,320	170	193	164	[illegible]
26	219	211	207	128	115	66	765	940	166	192	160	[illegible]
27	218	211	206	127	116	66	960	740	166	195	161	[illegible]
28	218	211	204	124	115	66	1,065	940	166	194	162	[illegible]
29	218	211	203	124	113	66	910	780	162	187	163	[illegible]
30	218	.....	197	124	109	64	2,055	720	158	186	164	[illegible]
31	218	.....	195	.....	107	.....	1,010	660	.....	184	.....	[illegible]

Estimated monthly discharge of Salt River at Roosevelt, Ariz., for 1904.

[Drainage area, 5,756 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth inches
January	224	218	221	13,590	0.038	[illegible]
February	224	211	215	12,370	.037	[illegible]
March	229	195	217	13,340	.038	[illegible]
April	195	124	148	8,807	.026	[illegible]
May	296	107	132	8,116	.023	[illegible]
June	105	64	79.5	4,731	.014	[illegible]
July	2,055	50	356	21,890	.062	[illegible]
August	14,700	380	1,513	93,030	.263	[illegible]
September	1,970	158	460	27,370	.080	[illegible]
October	690	146	281	17,280	.049	[illegible]
November	175	160	164	9,759	.028	[illegible]
December	234	158	172	10,580	.030	[illegible]
The year	14,700	50	330	240,900	.057	[illegible]

NOTE.—The above estimates have been prepared by interpolation based upon the discharge measurements and gage heights.

SALT RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897, by J. B. Lippincott. It is located one-third mile above the junction of the Salt and Verde rivers, 30 miles northeast of Phoenix, 15 miles northeast of Mesa, and 1¼ miles above the Arizona canal diversion dam. There have been three gages in use at this station, as follows:

Gage No. 1, set by J. B. Lippincott April 20, 1897, was a 2 by 6 inch timber bolted to the rocks on the south bank of the river about one-fourth mile above the cable, from which discharge measurements are made. This gage, which has since been removed, was used until November 30, 1899, when the station was temporarily abandoned. The bench mark is a nail in a palo verde tree about 75 feet west of cable anchorage on the north bank. Its elevation is 17.33 feet above the zero of the gage.

In 1901 observations were resumed, and gage No. 2 was established by J. F. Appleby. It consists of a 2 by 6 inch timber fastened to a tree on the north bank of the river three-fourths mile above the cable. The zero of the gage is 1,323.54 feet above sea level, and its bench mark is a nail in a root of the willow tree to which the gage is fastened. Its elevation is 1,328.69 feet above sea level and 5.10 feet above the zero of the gage. On April 2, 1903, high water in the Verde River backed up the water on gage No. 2 and changed the cross section by depositing sand.

Gage No. 3 was established May 19, 1903, by W. W. Schlecht. It consists of a 1 by 6 inch stadia rod spiked to a 2 by 4 inch timber and fastened to a tree on the south bank 1¼ miles above the cable. The water surface at this gage is about 15 feet higher than at the mouth of the Verde River, and the zero of the gage is 1,336.27 feet above sea level. Three bench marks have been established for gage No. 3: First, a nail in a mesquite stump 200 feet east of Peters's corral. Its elevation is 1,363.2 feet above sea level and 26.93 feet above the zero of the gage. Second, a nail in a root of a mesquite tree on the top of the bank 50 feet northwest of the northwest corner of Peters's corral and about 75 feet from the gage. Its elevation is 1,356 feet above sea level and 19.73 feet above the zero of the gage. Third, a nail in the willow tree to which the gage is attached. Its elevation is 1,344.27 feet above sea level and 8.00 feet above the zero of the gage. The observer is W. Richins, who also makes the discharge measurements.

Discharge measurements are made by means of a cable and car. The south end of the cable is anchored to the rocks and the north end is run over an 8 by 8 inch standard 21 feet high. During low water discharge measurements are made by wading about 1,000 feet upstream from the cable where a tag wire has been placed. The initial point for soundings is 120 feet south of the standard under the cable at the

north bank. The channel is straight for about 500 feet above and below the station. The current is swift. The right bank is about 3½ feet high at the water's edge and rises with a gradual slope for 400 feet. It is clean and subject to overflow. The left bank rises vertically for about 5 feet, when there is a small bench from which the rocks rise to a considerable height. The bank is clean and is not subject to overflow. The bed of the stream is composed of sand and is shifting, and it is necessary to make a large number of measurements in order to obtain an accurate estimate of the discharge.

The 1903 rating tables do not apply to the gage heights from April 2, 1903, until readings were begun on the new gage, May 19, 1903.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Discharge measurements of Salt River at McDowell, Ariz., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 1	W. Richins	145	1.30	1.46	188
January 6	do	146	1.33	1.46	194
January 9	do	145	1.31	1.46	190
January 12	do	147	1.32	1.47	194
January 15	do	145	1.32	1.46	191
January 18	do	141	1.29	1.45	182
January 22	do	149	1.27	1.47	189
January 26	do	147	1.24	1.46	182
January 29	do	143	1.15	1.45	164
February 2	do	138	1.20	1.44	165
February 5	do	138	1.18	1.45	163
February 9	do	146	1.30	1.50	190
February 12	do	124	1.26	1.45	156
February 16	do	120	1.38	1.47	165
February 19	do	121	1.36	1.46	165
February 23	do	139	1.39	1.51	194
February 26	do	129	1.33	1.47	171
March 1	do	130	1.36	1.50	177
March 4	do	135	1.36	1.50	184
March 8	do	129	1.43	1.49	184
March 11	do	120	1.34	1.45	161
March 14	do	124	1.35	1.45	167
March 18	do	118	1.27	1.42	150
March 22	do	115	1.26	1.40	145
March 25	do	127	1.29	1.45	164
March 29	do	121	1.38	1.45	167

[a] Gage No. 3.

Discharge measurements of Salt River at McDowell, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 1	W. Richins	115	1.32	1.42	152
April 5	do	125	1.38	1.46	173
April 8	do	117	1.27	1.40	148
April 12	do	114	1.24	1.37	141
April 15 [a]	do	88	1.43	1.33	126
April 19 [a]	do	87	1.39	1.32	121
April 22 [a]	do	85	1.28	1.29	109
April 26 [a]	do	88	1.36	1.32	120
April 29 [a]	do	84	1.27	1.29	107
May 3 [a]	do	82	1.32	1.29	108
May 6 [a]	do	82	1.25	1.28	103
May 10 [a]	do	83	1.29	1.28	107
May 13 [a]	do	96	1.49	1.37	143
May 17 [a]	do	99	1.57	1.39	155
May 20 [a]	do	86	1.39	1.32	120
May 24 [a]	do	84	1.35	1.28	113
May 27 [a]	do	82	1.28	1.24	105
May 31 [a]	do	78	1.18	1.21	92
June 3 [a]	do	73	1.12	1.16	82
June 7 [a]	do	67	1.13	1.12	76
June 10 [a]	do	67	1.05	1.10	70
June 14 [a]	do	62	1.12	1.13	70
June 17 [a]	do	59	1.02	1.06	60
June 21 [a]	do	51	1.00	1.02	51
June 24 [a]	do	49	1.01	1.01	50
June 28 [a]	do	51	1.11	1.05	57
July 1 [a]	do	47	1.04	1.01	49
July 5 [a]	do	50	1.10	1.05	55
July 8 [a]	do	48	1.03	1.03	49
July 12 [a]	do	48	1.04	1.03	50
July 15 [a]	do	43	.91	.94	39
July 19 [a]	do	42	.95	.95	40
July 22 [a]	do	47	1.15	1.03	54
July 23	do	578	6.59	4.25	3,810
July 26	do	295	2.03	2.17	598
July 27	do	859	3.85	4.40	3,307
July 29	do	293	1.54	1.90	450
August 2	do	336	1.98	2.25	664
August 5	do	392	2.27	2.65	891

[a] Measurement made 1,000 feet upstream from cable station.

Discharge measurements of Salt River at McDowell, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet*
August 9	W. Richins	257	1.98	2.00	510
August 12	do	279	1.88	1.90	525
August 16	do	298	2.15	2.07	642
August 19	do	646	3.87	3.60	2,499
August 23	do	2,273	5.72	8.40	13,010
August 26	do	526	2.17	3.60	1,142
August 30	do	464	2.14	3.40	994
September 2	do	413	2.44	3.60	1,010
September 6	do	264	1.57	2.40	416
September 9	do	215	1.35	2.07	290
September 13	do	631	5.22	4.92	3,292
September 16	do	370	2.19	2.70	811
September 20	do	167	1.56	1.90	260
September 30	do	128	1.27	1.72	162
October 4	do	139	1.28	1.75	178
October 7	do	127	1.27	1.72	161
October 11	do	177	1.78	1.95	315
October 14	do	233	1.98	2.23	461
October 18	do	173	1.72	1.97	297
October 25	do	145	1.57	1.83	228
October 28	do	139	1.40	1.79	194
November 1	do	138	1.37	1.78	189
November 4	do	136	1.38	1.77	187
November 11	do	124	1.41	1.74	175
November 15	do	122	1.48	1.76	181
November 18	do	118	1.37	1.74	161
November 22	do	129	1.31	1.76	169
November 29	do	136	1.26	1.76	172
December 6	do	144	1.25	1.78	181
December 9	do	143	1.57	1.88	225
December 13	do	133	1.51	1.86	201
December 16	do	142	1.44	1.86	205
December 20	do	124	1.34	1.83	166
December 23	do	124	1.46	1.82	181
December 27	do	136	1.45	1.85	197
December 30	do	124	1.46	1.82	181

Mean daily gage height, in feet, of Salt River at McDowell, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.46	1.43	1.50	1.42	a1.28	1.18	1.02	2.65	3.63	1.72	1.78	1.76
2	1.47	1.43	1.50	1.43	1.28	1.17	1.03	2.17	3.45	a1.72	1.78	1.76
3	a1.46	1.43	1.50	a1.44	1.29	1.15	1.03	1.97	3.18	1.72	1.77	1.77
4	1.46	1.44	1.50	1.45	1.26	1.13	1.04	2.83	a3.05	1.76	1.77	a1.78
5	1.46	1.44	1.49	1.45	1.27	a1.13	1.03	2.83	2.92	1.71	1.76	1.79
6	1.46	1.47	1.49	1.44	1.27	1.13	1.04	2.02	2.35	1.76	1.77	1.79
7	1.45	a1.50	1.48	1.41	1.26	1.12	1.04	2.90	2.20	1.72	1.77	1.84
8	1.46	1.52	1.48	1.40	a1.26	1.10	1.02	2.90	2.15	2.21	1.77	1.88
9	1.46	1.50	1.47	1.39	1.27	1.11	1.02	1.87	2.06	2.10	1.77	1.88
10	a1.46	1.47	1.45	1.37	1.28	1.10	a1.02	1.88	2.00	2.08	1.76	1.88
11	1.46	1.47	1.45	1.38	1.37	1.09	1.02	2.32	a1.95	1.92	1.74	a1.87
12	1.47	1.45	1.42	1.36	1.33	1.10	1.03	2.00	1.90	2.13	1.74	1.86
13	a1.46	1.45	1.45	1.36	1.36	1.14	.95	1.90	4.85	2.31	a1.75	1.86
14	1.46	a1.46	1.45	1.34	1.36	1.13	.94	3.30	2.30	2.22	1.76	1.85
15	1.46	1.47	1.44	1.33	1.46	1.09	.94	2.07	2.90	2.13	1.76	1.84
16	1.45	1.47	1.44	1.33	1.50	1.06	.93	d2.50	2.75	a2.08	1.75	1.86
17	a1.45	1.47	1.43	1.33	1.40	1.06	.95	d3.15	2.40	2.03	1.74	1.85
18	1.45	1.46	1.42	1.32	1.34	1.05	.95	4.27	a2.26	1.96	1.74	a1.84
19	1.46	1.46	1.41	1.31	1.34	1.04	.95	e3.55	2.13	1.91	1.74	1.83
20	1.46	1.46	1.40	1.30	1.32	1.03	.95	3.35	1.90	1.88	a1.74	1.82
21	1.46	a1.46	1.40	1.28	1.31	1.02	.98	3.51	1.84	1.86	1.75	1.82
22	1.47	1.47	1.40	1.29	a1.30	1.02	1.04	3.37	1.78	1.85	1.76	1.81
23	1.47	1.50	1.41	1.30	1.29	1.01	b3.40	8.65	1.80	a1.84	1.76	1.82
24	a1.46	1.47	1.43	a1.31	1.28	1.01	1.58	f5.50	1.80	1.84	1.76	1.84
25	1.46	1.47	1.45	1.32	1.28	1.01	1.28	f4.15	1.77	1.82	1.76	a1.84
26	1.45	1.46	1.45	1.31	1.25	1.01	1.25	3.45	1.76	1.81	1.76	1.84
27	1.46	1.46	1.45	1.30	1.24	1.05	c3.70	3.27	1.75	1.79	1.76	1.84
28	1.45	a1.48	1.45	1.29	1.24	1.05	2.37	4.00	1.73	1.79	1.76	1.83
29	1.45	1.49	1.44	1.28	1.24	1.03	1.98	3.62	1.73	1.79	1.76	1.82
30	1.45	.....	1.43	1.27	1.22	1.02	4.85	3.35	1.72	1.80	1.76	1.82
31	a1.44	.....	1.42	.....	1.20	.....	2.60	3.70	.....	1.78	.....	1.81

a Interpolated gage height.
b Freshet July 23—gage height 9 a. m., 4.5 feet; 11 a. m., 4 feet.
c July 27, gage height 11 a. m., 8 feet; 12 m., 5.2 feet; 2 p. m., 4 feet.
d Night of Aug. 16–17, gage height 8.7 feet.
e Aug. 19, 12 m., the gage read 4.4 feet.
f Night Aug. 24–25, gage height 9.5 feet.

NOTE.—All readings from gage No. 3.

Mean daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	189	161	177	152	105	85	51	1,050	1,070	162	188	17
2	193	162	179	157	105	84	52	600	1,010	162	190	17
3	191	160	182	162	108	79	52	415	760	161	186	17
4	192	161	184	168	99	76	53	1,115	700	184	187	18
5	193	160	182	170	101	77	51	1,070	640	154	181	18
6	194	172	182	165	100	77	52	410	395	184	187	18
7	190	185	180	153	98	76	52	1,240	335	161	187	20
8	191	194	180	148	99	71	47	1,310	320	460	187	23
9	190	190	174	145	103	73	48	420	287	397	187	25
10	190	174	165	140	107	70	48	450	267	389	181	22
11	190	168	161	144	137	66	48	840	250	297	169	23
12	194	156	153	138	128	66	50	600	236	415	169	24
13	191	157	165	137	140	74	39	520	3,200	515	175	20
14	191	160	167	130	142	70	38	2,060	510	455	181	19
15	191	164	162	126	174	63	39	645	970	400	181	19
16	186	165	160	126	157	58	38	1,040	850	368	172	20
17	184	166	155	125	158	60	40	1,820	575	337	163	19
18	182	164	150	121	135	58	40	3,670	485	293	160	19
19	185	165	147	118	131	55	40	2,420	400	265	161	18
20	186	168	145	114	120	53	40	2,120	260	249	161	18
21	186	172	145	107	118	51	45	2,360	225	239	167	18
22	189	178	145	109	116	51	56	2,140	190	235	173	17
23	188	191	149	113	115	50	2,340	13,700	203	230	173	18
24	184	178	157	116	113	50	320	2,200	204	232	173	1
25	183	174	164	120	114	50	130	1,640	188	222	173	18
26	179	168	165	117	107	50	100	1,030	182	213	172	18
27	177	167	165	113	105	57	2,150	900	177	198	172	18
28	169	172	166	108	104	57	720	1,500	166	194	172	18
29	164	175	164	104	103	53	510	1,150	167	194	172	18
30	165	.....	159	102	96	51	4,650	994	162	200	172	18
31	163	.....	154	.....	89	.....	1,020	1,170	.....	188	.....	17

Estimated monthly discharge of Salt River at McDowell, Ariz., for 1904.

[Drainage area, 6,260 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	194	163	185	11,380	0.030	0.035
February	194	156	170	9,779	.027	.029
March	184	145	164	10,080	.026	.030
April	170	102	132	7,855	.021	.023
May	174	89	117	7,194	.019	.022
June	85	50	63.7	3,790	.010	.011
July	4,650	38	418	25,700	.067	.077
August	13,700	410	1,697	104,300	.271	.312
September	3,200	162	513	30,530	.082	.091
October	515	154	269	16,540	.043	.050
November	190	160	176	10,470	.028	.031
December	230	170	192	11,810	.031	.036
The year	13,700	38	341	249,400	.055	.747

NOTE.—The above estimates have been prepared by interpolation based upon the discharge measurements and gage heights.

TONTO CREEK AT ROOSEVELT, ARIZ.

This station, established April 1, 1901, by H. G. Heisler, is located at the town of Roosevelt and about 12 miles west of Livingston. This station was called Tonto Creek near Livingston in reports previous to 1903.

The gage, a vertical rod fastened to a cliff of cemented gravel on the left bank, was about 3,500 feet above the mouth of the creek. Measurements were made by wading with meter during low water and by means of floats over a course of 25 feet during floods. The channel is straight for about 300 feet above and 1,000 feet below the station. The current above the station is swift at high stages and swift below the station. The right bank is high, and is not subject to overflow. The left bank is low, wooded, and liable to overflow. The bed of the stream is composed of sand and gravel and is shifting. This station was abandoned the latter part of August, 1904, owing to the destruction of the gage by a flood. All the water is measured at the Roosevelt station on Salt River, immediately below.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Mean daily gage height, in feet, of Tonto Creek at Roosevelt, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug
1	3.25	3.25	3.25	3.25	3.25	3.25	3.25	4.
2	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
3	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
4	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
5	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
6	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3
7	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
8	3.25	3.25	3.25	3.25	3.25	3.25	3.25	
9	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
10	3.25	3.25	3.25	3.25	3.25	3.25	3.25	4.
11	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
12	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
13	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
14	3.25	3.25	3.25	3.25	3.25	3.25	3.25	4.
15	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
16	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
17	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
18	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
19	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
20	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
21	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.
22	3.25	3.25	3.25	3.25	3.25	3.25	5.37	3.
23	3.25	3.25	3.25	3.25	3.25	3.25	4.25	3.
24	3.25	3.25	3.25	3.25	3.25	3.25	3.45	4.
25	3.25	3.25	3.25	3.25	3.25	3.25	5.47	3.
26	3.25	3.25	3.25	3.25	3.25	3.25	5.29	3.
27	3.25	3.25	3.25	3.25	3.25	3.25	5.85	3.
28	3.25	3.25	3.25	3.25	3.25	3.25	5.62	3.
29	3.25	3.25	3.25	3.25	3.25	3.25	5.75	3.
30	3.25	.....	3.25	3.25	3.25	3.25	6.05	3
31	3.25	.....	3.25	.....	3.25	.....	6.20	3.

VERDE RIVER AT McDOWELL, ARIZ.

This station was established April 20, 1897, by J. B. Lippincott. It is located 30 miles northeast of Phoenix, 15 miles northeast of Mesa, 2⅛ miles above the Arizona Canal diversion dam, and three-fourths of a mile above the mouth of the river. Three gages have been in use at this station, as follows:

Gage No. 1 was established April 20, 1897, by J. B. Lippincott. It consisted of a vertical rod attached to a large cottonwood tree on the east bank about 60 feet below the cable. Readings were taken from this gage until November 11, 1899, when the station was temporarily abandoned. The bench mark is a point on a cats-claw (Acacia) tree about 100 feet southeast of the gage. Its elevation is 27.02 feet above the zero of the gage.

Gage No. 2 was established in January, 1901, by H. G. Heisler, and observations were resumed. It is an inclined 2 by 4 inch timber, fastened to the rocks on the west bank about 500 feet above the cable, to

zero of the gage being 1,325.4 feet above sea level. Three bench marks have been established for gage No. 2. First, a nail in a mesquite tree about 6 feet below the cable anchorage on the east bank; its elevation is 1,345.5 feet above sea level, and 20.10 feet above the zero of the gage. Second, a nail in the cable standard at the east bank; its elevation is 1,341.3 feet above sea level, and 15.90 feet above the zero of the gage. Third, a mark on rock at the gage; its elevation is 1,330.4 feet above sea level, and 5.00 feet above the zero of the gage.

On account of water piling up at gage No. 2 during flood, gage No. 3 was established May 16, 1904, by C. G. Williams. It is a vertical 1¼ by 6 inch rod spiked to a 2 by 6 inch timber fastened to a willow tree on the east bank about one-half mile above the cable. The zero of the gage is 1,339.26 feet above sea level. Two bench marks have been established for gage No. 3. First, a nail in a large cottonwood tree on the top of the east bank near the gage; its elevation is 1,354.11 feet above sea level, and 14.85 feet above the zero of the gage. Second, a nail in the willow tree to which the gage is attached; its elevation is 1,347.26 feet above sea level, and 8.00 feet above the zero of the gage. The observer is W. Richins, who also makes the discharge measurements.

Discharge measurements are made by means of a cable, car, and tagged wire. At low water the channel is oblique to the gaging section and measurements are made by wading at a point 400 feet above the cable. The channel is straight for a distance of 300 feet above and below the station, and has a width at low water of 100 feet and at high water of 450 feet. The current is swift. The right bank is high, rocky, clean, and is not subject to overflow; the left bank is low, clean, and is subject to overflow. The bed of the stream is composed of sand and is shifting.

The observations at this station during 1904 have been made under the direction of C. G. Williams, district hydrographer.

Discharge measurements of Verde River at McDowell, Ariz., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 1	W. Richins	119	1.97	2.19	235
January 6	do	119	2.01	2.19	239
January 9	do	128	1.97	2.20	252
January 12	do	125	2.00	2.20	250
January 15	do	116	1.94	2.15	225
January 18	do	115	1.98	2.13	228
January 22	do	124	2.05	2.13	254
January 26	do	115	2.01	2.12	231

Discharge measurements of Verde River at McDowell, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet*
January 29	W. Richins	112	2.01	2.10	225
February 2	do	112	2.03	2.10	227
February 5	do	117	2.05	2.10	240
February 9	do	112	2.11	2.10	236
February 12	do	105	2.28	2.06	239
February 16	do	102	2.16	2.00	220
February 19	do	100	2.22	2.00	222
February 23	do	97	2.24	1.99	217
February 26	do	93	2.27	1.95	211
March 1	do	94	2.34	1.92	220
March 4	do	84	2.19	1.85	184
March 8[a]	do	85	1.58	1.80	134
March 11[a]	do	90	1.74	1.82	157
March 14[a]	do	91	1.80	1.87	164
March 18[a]	do	100	1.97	1.92	197
March 22[a]	do	99	2.07	1.92	205
March 25[a]	do	96	2.31	1.99	222
March 29[a]	do	95	2.02	1.88	192
April 1[a]	do	89	1.97	1.83	175
April 5[a]	do	84	1.81	1.79	152
April 8[a]	do	84	1.67	1.74	140
April 12[a]	do	75	1.53	1.65	115
April 15[a]	do	75	1.45	1.64	109
April 19[a]	do	74	1.31	1.60	97
April 22[a]	do	75	1.37	1.63	103
April 26[a]	do	77	1.32	1.62	102
April 29[a]	do	75	1.28	1.59	96
May 3[a]	do	76	1.24	1.58	94
May 6[a]	do	77	1.38	1.62	106
May 10[a]	do	71	1.31	1.52	93
May 13[a]	do	71	1.42	1.53	101
May 17[a]	do	99	2.12	1.82	210
May 20[a]	do	75	1.80	1.49	135
May 24[a]	do	70	1.50	1.36	105
May 27[a]	do	66	1.38	1.31	91
May 31[a]	do	66	1.37	1.27	90
June 3[a]	do	63	1.29	1.23	81
June 7[a]	do	62	1.29	1.21	80
June 10[a]	do	62	1.29	1.21	80

[a] Measurement made at temporary station 400 feet upstream from cable station.

Discharge measurements of Verde River at McDowell, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 14 [a]	W. Richins	56	1.16	1.16	65
June 17 [a]	do	55	1.13	1.14	62
June 21 [a]	do	53	.96	1.08	51
June 24 [a]	do	50	.86	1.02	43
June 28 [a]	do	52	.98	1.06	51
July 1 [a]	do	49	.96	1.02	47
July 5 [a]	do	48	.92	1.01	44
July 8 [a]	do	49	.94	1.02	46
July 12 [a]	do	50	.94	1.02	47
July 15 [a]	do	46	.87	.99	40
July 19 [a]	do	42	.76	.92	32
July 22 [b]	do	102	1.38	.50	141
July 26 [b]	do	347	2.89	2.02	1,003
July 27 [b]	do	1,233	5.23	5.30	6,450
July 29 [b]	do	449	2.98	2.33	1,340
July 31 [b]	do	1,178	5.15	5.42	6,070
August 2 [b]	do	409	2.77	2.32	1,133
August 5 [b]	do	383	2.94	2.10	1,125
August 9 [b]	do	319	2.59	1.75	826
August 12 [b]	do	519	3.88	2.83	2,014
August 16 [b]	do	276	3.05	1.55	841
August 19 [b]	do	370	3.36	1.95	1,244
August 23 [b]	do	815	6.36	5.10	5,184
August 26 [b]	do	377	3.55	2.55	1,340
August 30 [b]	do	435	3.89	2.50	1,693
September 2 [b]	do	319	2.94	1.95	938
September 6 [b]	do	207	2.47	1.50	513
September 9 [b]	do	160	2.24	1.05	359
September 13 [b]	do	339	3.27	1.95	1,109
September 16 [b]	do	224	2.26	1.50	506
September 20 [b]	do	146	2.10	1.15	307
September 30 [b]	do	87	2.03	.68	177
October 4 [b]	do	100	2.00	.72	200
October 7 [b]	do	94	1.87	.68	176
October 11 [b]	do	96	2.10	.75	202
October 14 [b]	do	94	2.15	.72	202
October 18 [b]	do	85	1.94	.70	165
October 25 [b]	do	97	2.08	.74	202
October 28 [b]	do	91	2.13	.75	194
November 1 [b]	do	93	2.07	.78	193
November 4 [b]	do	101	2.04	.79	206
November 11 [b]	do	95	2.11	.84	200
November 15 [b]	do	105	2.01	.87	211
November 18 [b]	do	104	2.05	.90	213
November 29 [b]	do	104	2.09	.95	217
November 29 [b]	do	108	1.99	.94	215

[a] Measurement made at temporary station 400 feet upstream from cable station.
[b] Gage heights from July 21 to December 31 taken from gage No. 3. Measurement made at cable station. All other gage heights from gage No. 2.

Discharge measurements of Verde River at McDowell, Ariz., in 1904—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
December 6 [a]	W. Richins	113	2.05	.98	232
December 9 [a]	do	121	2.34	1.05	283
December 13 [a]	do	114	2.25	1.02	256
December 16 [a]	do	106	2.08	1.03	221
December 20 [a]	do	116	2.15	1.06	249
December 23 [a]	do	118	2.22	1.07	262
December 27 [a]	do	111	2.06	1.04	229
December 30 [a]	do	111	2.17	1.08	241

[a] Gage heights from July 21 to December 31 taken from gage No. 3. Measurement made at cable station. All other gage heights from gage No. 2.

Mean daily gage height, in feet, of Verde River at McDowell, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.19	2.10	1.92	1.82	[a] 1.57	1.25	1.02	2.95	2.07	0.68	0.78	0.97
2	2.19	2.10	1.92	1.81	1.57	1.24	1.02	2.32	1.90	[a] .68	.79	.97
3	[a] 2.19	2.10	1.89	[a] 1.80	1.58	1.23	[a] 1.01	2.10	1.75	.72	.78	.96
4	2.19	2.10	1.84	1.80	1.62	1.22	1.00	2.18	[a] 1.71	.75	.79	[a] .97
5	2.19	2.09	1.82	1.78	1.62	[a] 1.22	1.01	2.18	1.67	.68	.79	.98
6	2.19	2.12	1.82	1.75	1.62	1.21	1.00	[c] 1.90	1.37	.66	.84	.99
7	2.18	[a] 2.11	1.81	1.74	1.60	1.20	1.01	[c] 1.80	1.19	.68	.84	1.00
8	2.19	2.10	1.80	1.73	[a] 1.57	1.21	1.01	1.55	1.15	.66	.84	1.04
9	2.20	2.10	1.79	1.72	1.54	1.21	1.02	1.77	1.05	[a] .67	.85	1.05
10	[a] 2.20	2.10	1.80	[a] 1.70	1.52	1.20	[a] 1.02	1.45	1.05	.73	.84	1.05
11	2.20	2.08	1.82	1.67	1.51	1.20	1.01	1.82	[a] 1.05	.75	.84	[a] 1.04
12	2.19	2.06	1.83	1.64	1.62	1.19	1.02	2.85	1.05	.73	.83	1.02
13	[a] 2.17	2.05	[a] 1.85	1.65	1.52	1.17	1.00	1.90	2.80	.72	[a] .85	1.02
14	2.15	[a] 2.03	1.87	1.63	2.28	1.16	.99	2.22	1.80	.71	.87	1.04
15	2.15	2.01	1.88	1.63	2.23	1.14	.97	2.05	1.65	.71	.88	1.03
16	2.13	2.00	1.91	1.61	1.91	1.13	.97	1.65	1.50	[a] .72	.90	1.03
17	[a] 2.13	2.00	1.92	[a] 1.60	1.79	1.13	[a] .95	3.80	1.40	.72	.90	1.03
18	2.13	1.99	1.92	1.59	1.67	1.11	.93	2.42	[a] 1.28	.70	.90	[a] 1.04
19	2.13	2.00	1.91	1.60	1.56	1.10	.92	2.43	1.17	.68	.91	1.05
20	2.13	2.01	[a] 1.91	1.62	1.48	[a] 1.08	.92	[c] 2.30	1.15	.68	[a] .92	1.06
21	2.13	[a] 2.00	1.91	1.61	1.42	1.08	[b] 1.45	1.90	1.09	.69	.93	1.07
22	2.13	2.00	1.92	1.63	[a] 1.40	1.06	.45	2.85	.97	.72	.95	1.08
23	2.12	1.99	1.93	1.63	1.39	1.04	1.15	4.60	.88	[a] .72	.94	1.08
24	[a] 2.12	1.97	1.98	[a] 1.62	1.36	1.02	.56	4.10	.80	.73	.93	1.07
25	2.13	1.97	1.99	1.60	1.35	1.01	.64	3.17	.78	.74	.94	[a] 1.06
26	2.12	1.94	1.95	1.62	1.33	[a] 1.02	2.02	2.65	.77	.75	.92	1.04
27	2.10	1.93	[a] 1.92	1.64	1.30	1.03	4.85	2.42	.73	.75	.93	1.04
28	2.10	[a] 1.92	1.89	1.63	1.30	1.06	2.20	[c] 3.80	.72	.75	.94	1.05
29	2.10	1.92	1.87	1.59	1.31	1.04	2.35	2.40	.69	.75	.94	1.07
30	2.09	.....	1.86	1.57	1.28	1.01	4.85	2.45	.68	[a] .76	.94	1.08
31	[a] 2.10	.....	1.85	.....	1.26	.....	5.40	2.15	.....	.78	.....	1.08

[a] Interpolated gage height.
[b] Freshet July 21. Gage height 7 a. m., 2 feet; 12 m., 2.40 feet; 6 p. m., 0.9 feet.
[c] Gage height August 6, 7, 20, and 28 estimated.

NOTE.—Gage height January 1 to July 20 from gage No. 2; July 21 to December 31 from gage No. 3.

Mean daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	235	226	220	173	92	83	45	1,850	1,090	181	193	119
2	236	227	214	167	92	81	45	1,133	890	184	199	222
3	237	231	209	161	94	79	43	975	740	197	200	224
4	237	236	182	158	104	78	42	1,135	690	207	206	227
5	238	237	168	150	105	78	43	1,210	645	186	203	231
6	239	244	158	142	106	76	42	930	430	176	213	234
7	240	240	146	140	103	74	43	850	365	176	210	248
8	246	237	134	138	99	76	43	650	375	174	208	269
9	252	236	137	134	95	76	45	840	359	178	207	283
10	251	241	146	129	93	74	45	565	365	195	202	278
11	251	240	157	120	92	74	43	840	375	202	200	271
12	247	239	158	113	118	72	45	2,050	385	200	200	261
13	238	236	161	114	99	69	42	960	2,210	200	206	256
14	229	230	164	108	322	67	41	1,370	880	200	212	249
15	225	224	172	107	310	63	38	1,270	670	192	216	234
16	223	220	184	102	233	62	38	935	506	186	218	221
17	226	221	192	99	205	62	36	4,150	440	177	215	226
18	228	219	197	96	166	59	34	1,850	375	165	213	234
19	234	222	197	97	149	57	32	1,850	315	165	213	242
20	241	224	198	101	132	54	32	1,430	307	168	214	249
21	248	222	201	99	118	54	530	850	285	175	214	255
22	254	220	205	103	114	51	135	1,780	243	186	217	256
23	246	217	207	104	112	48	360	4,500	215	190	215	260
24	242	214	219	101	105	45	150	3,650	193	196	213	254
25	239	214	221	98	103	43	170	2,150	190	202	215	246
26	231	208	212	102	99	45	1,008	1,460	190	201	210	235
27	226	210	208	107	93	46	5,600	1,280	183	198	212	229
28	226	212	195	105	93	51	1,200	3,525	183	194	215	235
29	225	216	190	96	95	48	1,360	1,460	177	192	215	238
30	224	.....	186	92	89	43	5,250	1,630	177	192	215	241
31	226	.....	181	.....	85	.....	6,080	1,230	.....	195	.....	241

Estimated monthly discharge of Verde River at McDowell, Ariz., for 1904.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	254	223	237	14,570	0.040	0.046
February	244	208	226	13,000	.038	.041
March	221	134	184	11,310	.031	.036
April	173	92	119	7,081	.020	.022
May	322	85	126	7,747	.021	.024
June	83	43	62.9	3,743	.010	.011
July	6,030	32	729	44,820	.122	.141
August	4,500	565	1,624	99,860	.271	.312
September	2,210	177	482	28,680	.080	.089
October	207	165	188	11,560	.031	.036
November	218	193	210	12,500	.035	.039
December	283	119	241	14,820	.040	.046
The year	6,030	32	369	269,700	.062	.843

NOTE.—The above estimates have been prepared by interpolation based upon the discharge measurements and gage heights.

MISCELLANEOUS DISCHARGE MEASUREMENTS IN THE COLORADO RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Colorado River drainage basin in 1904:

Miscellaneous discharge measurements in Colorado River drainage basin.

Date.	Hydrographer.	Stream.	Locality.	Discharge.
				Sec.-feet
Aug. 30	Oro McDermith..	Chimney Creek..	Yampa, Colo.....	13
June 18	.....do.....	.....do.....	.....do.....	16
June 23	.....do.....	Elkhead Creek...	Craig, Colo.....	59
May 1	.....do.....	.....do.....	Hayden, Colo.....	822
Apr. 30	.....do.....	Fortification Creek	Craig, Colo.....	219
Aug. 29	.....do.....	Grand.....	Wolcott, Colo.....	1,693
Sept. 1	W. A. Lamb.....	Grand Lake.....	East Inlet to.....	99
Oct. 5	.....do.....	.....do.....	.....do.....	16
Aug. 16	.....do.....	.....do.....	.....do.....	42
Sept. 2	.....do.....	.....do.....	North Inlet to.....	93
Oct. 5	.....do.....	.....do.....	.....do.....	22
Aug. 16	.....do.....	.....do.....	North Outlet to.....	45
Aug. 24	Oro McDermith..	Hunt Creek.....	Yampa, Colo.....	13
June 17	.....do.....	.....do.....	.....do.....	43
Apr. 29	.....do.....	Marapos Creek...	Hamilton, Colo.....	146
Aug. 29	.....do.....	Rock Creek.....	McCoy, Colo.....	37
Nov. 4	R. C. Prewitt....	San Juan River ..	Farmington, N. Mex....	1,064
Nov. 25	.....do.....	.....do.....	.....do.....	514
Dec. 10	.....do.....	.....do.....	.....do.....	427
July 25	Oro McDermith..	Soda Creek.....	Steamboat, Colo.....	11
May 5	W. A. Lamb.....	.....do.....	Steamboat Springs, Colo.	86
May 5	.....do.....	Spring Creek	.....do.....	36
June 21	Oro McDermith..	.....do.....	Steamboat, Colo.....	41
June 20	.....do.....	Walton Creek....	Sidney, Colo.....	275
July 25	.....do.....	.....do.....	Steamboat, Colo.....	3.7
Apr. 13	.....do.....	White River.....	Whiteriver, Colo.....	596
July 14	.....do.....	.....do.....	.....do.....	568
Aug. 25	.....do.....	Yampa River....	Yampa, Colo.....	22
June 18	.....do.....	.....do.....	.....do.....	134

Discharge measurement of La Plata canal near Hesperus, Colo., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet*
June 14	M. C. Hinderlider.....	8	4.8	0.94	0.85	4.5

Waste measurements in Colorado River drainage basin in 1904.

Date.	Hydrographer.	Stream.	Locality.	Discharge.
				Sec.-feet.
Oct. 10	W. V. Hardy and S. M. Smith.	New River	Brawley, Cal	208
Oct. 11	do	Alamo channel	Rockwood, Cal	43
		Canal No. 5	Bernice, Cal	(a)
Oct. 18	do	New River	Brawley, Cal	380
Oct. 18	do	Alamo channel	Rockwood, Cal	45
Oct. 19	do	Canal No. 5	Bernice, Cal	77
				502
Oct. 31	do	New River	Brawley, Cal	381
Nov. 1	do	Alamo channel	Rockwood, Cal	59
Nov. 1	do	Canal No. 5	Bernice, Cal	58
				498
Nov. 9	W. V. Hardy	New River	Brawley, Cal	318
Nov. 9	do	Alamo channel	Rockwood, Cal	49
Nov. 9	do	Canal No. 5	Bernice, Cal	0
				367
Nov. 16	do	New River	Brawley, Cal	270
Nov. 15	do	Alamo channel	Rockwood, Cal	117
Nov. 15	do	Canal No. 5	Bernice, Cal	1
				388
Nov. 24	do	New River	Brawley, Cal	311
Nov. 22	do	Alamo channel	Rockwood, Cal	81
Nov. 22	do	Canal No. 5	Bernice, Cal	3
				395
Nov. 30	do	New River	Brawley, Cal	231
Nov. 30	do	Alamo channel	Rockwood, Cal	73
Nov. 30	do	Canal No. 5	Bernice, Cal	0
				304
Dec. 6	do	New River	Brawley, Cal	257
Dec. 6	do	Alamo channel	Rockwood, Cal	46
Dec. 6	do	Canal No. 5	Bernice, Cal	0
				303

(a) No measurement made.

Waste measurements in Colorado River drainage basin in 1904—Continued.

Date.	Hydrographer.	Stream.	Locality.	Dis-charge.
				Sec.-ft.
Dec. 13	W. V. Hardy	New River	Brawley, Cal	[illegible]
Dec. 13	do	Alamo channel	Rockwood, Cal	[illegible]
Dec. 13	do	Canal No. 5	Bernice, Cal	[illegible]
Dec. 24	do	New River	Brawley, Cal	[illegible]
Dec. 24	do	Alamo channel	Rockwood, Cal	[illegible]
Dec. 24	do	Canal No. 5	Bernice, Cal	[illegible]

Miscellaneous discharge measurements in Colorado River drainage basin in 1903 and 19[illegible]

Date.	Hydrographer.	Stream.	Locality.	Gage height.	Dis-charge.
1903.				*Feet.*	Sec.-ft.
Mar. 4	W. D. Smith	Colorado Valley Pumping and Irrigation Co.'s canal.	At heading		30
May 9	do	do	do		51
June 17	do	do	do		46
June 19	do	do	do		44
June 30	do	do	do		48
July 1	do	do	do		46
July 18	do	do	do		42
July 29	do	do	do		50
Aug. 8	L. M. Barnes	do	do		51
Sept. 14	W. D. Smith	do	do		42
Oct. 19	do	do	do		32
Nov. 17	do	do	do		34
Dec. 18	do	do	do		37
1904.					
Feb. 22	W. D. Smith and S. M. Woodward.	Colorado Valley Pumping and Irrigation Co.'s canal.	At heading	1.11	14[illegible]
Feb. 22	do	do	do		9[illegible]
Feb. 23	do	do	do	.89	7[illegible]
Feb. 23	do	do	do		11[illegible]
Feb. 23	do	do	do		11[illegible]
Feb. 23	do	do	do		11[illegible]
1903.					
May 20	W. D. Smith	Ludy canal	At heading		6

Miscellaneous discharge measurements in Colorado River drainage basin in 1903 and 1904—Continued.

Date.	Hydrographer.	Stream.	Locality.	Gage height.	Discharge.
1903.				*Feet.*	*Sec.ft.*
June 5	W. D. Smith	Ludy canal	At heading		79
June 23	do	do	do		38
July 21	do	do	do		71
Sept. 11	do	do	do		63
Oct. 9	do	do	do		25
Oct. 24	do	do	do		66
Nov. 20	do	do	do		24
Dec. 7	do	do	do		37
Dec. 21	do	do	do		14
1904.					
May 8	W. D. Smith	Ludy canal	At heading		50
May 24	do	do	do		59
June 4	do	do	do		158
June 16	do	do	do		92
July 27	do	do	do		185
1903.					
June 5	W. D. Smith	Farmers' canal	At heading		25
June 23	do	do	do		38
1904.					
May 8	W. D. Smith	Farmers' canal	At heading		63
May 24	do	do	do		97
June 4	do	do	do		56
June 16	do	do	do		35
July 27	do	do	do		47
Aug. 9	S. M. Smith	do	do		70
1903.					
June 20	W. D. Smith	Rose flume	At Rose ranch[a]	0.96	10
June 20	do	do	do	.91	8.5
June 20	do	do	do	.86	8
June 20	do	do	do	.97	10
Oct. 1	do	do	do	.68	7
Oct. 1	do	do	do	.68	7
1904.					
Aug. 4	W. D. Smith	Imperial canal	At junction with Carter River, Mexico.		309
Aug. 3	do	Main channel, Imperial canal.	Below Bests' camp, Mexico.		525

[a] These measurements were made to rate flume for ascertaining duty of water on 12-acre alfalfa field.

Miscellaneous discharge measurements in Colorado River drainage basin in 1903 and 1904—Continued.

Date.	Hydrographer.	Stream.	Locality.	Gage height.	Discharge.
1904.				*Feet.*	*Sec.-ft.*
Aug. 3	W. D. Smith.....	Padrone River diversion (waste from Imperial canal).	At Bests' camp, Mexico.	.....	609
Oct. 12	S. M. Smith	New River.....	At Calexico, Cal..	.....	154
Nov. 2	W. V. Hardy and S. M. Smith.	.....do	.....do.....	.....	52
Nov. 10	S. M. Smith	.....do	.....do.....	.....	28
Nov. 17	W. V. Hardy	.....do	.....do.....	.....	24
Nov. 23	.....do	.....do	.....do.....	.....	20
Dec. 1	.....do	.....do	.....do.....	.....	18.6
Dec. 7	.....do	.....do	.....do.....	.....	16.7
Dec. 14	.....do	.....do	.....do.....	.....	22
Dec. 21	.....do	.....do	.....do.....	.....	10.2

Creeks and canals in northeastern Utah.

Date.	Hydrographer.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.				*Feet.*	*Sq. feet.*	*Ft. p. s.*	*Feet.*	*Sec.-ft.*
Mar. 15	H. S. Reed....	Pole Creek.....	Above mouth ..	12	6.75	1.10	.....	7.4
May 27	.....do.....	.....do.....	.....do.....	17	18.5	3.41	.....	63
Aug. 29	.....do.....	.....do.....	.....do.....	12	8.1	1.19	.....	9.7
May 24	.....do.....	Dry Fork.....	.....do.....	29	50	6.16	.....	308
July 14	.....do.....	Dry Gulch Creek	.....do.....	5.5	2	.90	.....	1.8
July 14	.....do.....	Government canal below post.	Below headgate.	6.5	4.6	1.91	.....	8.7
May 27	.....do.....	Farm Creek.....	Above mouth...	6.5	4.3	3.51	.....	15
May 16	.....do.....	Stream at lake[a] (tributary).	West Fork of Lake Creek.	12.5	12	8.09	.....	97
June 29	.....do.....	.....do.....	.....do.....	12	9	2.31	.....	21
June 28	.....do.....	Lake Creek	Below junction.	72	140	5.06	1.75	708

[a] This creek has good slope and could be used for waterpower.

GREAT BASIN DRAINAGE.

The Great Basin comprises an immense area of interior drainage in which the streams do not discharge into the ocean. This area is not one single drainage basin, but rather consists of a number of basins, some of which are connected while others are closed; the outer boundary of all, however, is at such an elevation that the region as a whole has no outlet. The Great Basin includes almost all of Nevada, western Utah, and contiguous parts of Idaho, Oregon, and California. It is rudely triangular in outline, resembling an isosceles triangle, the apex of the longer dimension extending almost to the Gulf of California.

This inclosed area is approximately 800 miles long from north to south, 500 miles broad in the widest part, and it has been estimated to include 208,500 square miles. The Great Basin is bordered on the west by the Sierra Nevada, on the north by the Columbia plateaus, and on the east by the Rocky Mountains and the Colorado plateaus. The southern extremity lies in the little-known area west of Colorado River and north of the Gulf of California.

Topographically this interior drainage area in general is characterized by isolated narrow mountain ranges trending north and south, which are separated by broad valleys. In altitude the Great Basin varies considerably. The valleys in the southern part are low, Death Valley being below sea level, while in the north the valleys have a general elevation of from 4,000 to 5,000 feet. The intervening highlands often rise several thousand feet above their bases, and some of the peaks of the bordering mountains attain elevations of 13,000 feet.

Upper branches of the intermontane valleys extend into the interior ranges as narrow drainage ways that are dry during most of the year, while the drainage from the high mountains on the east and west borders of the Great Basin passes through deep canyons into the broad valleys, where the perennial streams maintain lakes. Among these are Great Salt, Utah, and Sevier lakes in the eastern part, and Pyramid, Winnemucca, Honey, Walker, Mono, and Owens lakes in the western part of the Great Basin. With the exception of Utah Lake, which discharges by Jordan River into Great Salt Lake, the character of the others, in consequence of the concentration of salts due to evaporation, is saline. Shallow, temporary bodies of water accumulate in some of the broad intermontane valleys during the wet season, but completely evaporate during the summer, leaving broad, muddy plains called playas. Bear Lake, in the mountains of the eastern border, and Lake Tahoe, in the Sierras, near the western border of the basin, are large bodies of fresh water that drain, respectively, to Great Salt and Pyramid lakes.

Geologically the Great Basin is well known as the type region of the "Basin Range structure." Many of the isolated narrow mountain ranges that trend north and south are steep on one side, exposing cross sections of the rocks, and sloping on the other, conforming with the dip of the strata. These ranges have been uplifted by movements of the earth's crust, whereby it has been broken into tilted blocks. The greatest displacements of the Great Basin are associated with its eastern and western borders, the Wasatch Mountains and Sierra Nevada having been uplifted many thousand feet. The mountains of the Great Basin are commonly composed of Paleozoic strata, often modified by vulcanism, and the products of weathering and disintegration of these rocks have accumulated in the broad intervening valleys, which are strewn to great depths with unconsolidated débris.

The climate of the Great Basin is extremely arid, and excepting the few favored spots where irrigation flourishes, the region in general is desert. Over the larger part of the area the annual precipitation is less than 10 inches, the main amount occurring as snowfall on the high mountains. Temperature varies considerably consequent to the large extent of the area and to the differences in elevation. Over most of the region the heat of summer days is intense, but the diurnal variation is considerable. Evaporation is enormous. From the surface of water in the vicinity of Salt Lake City it has been found to amount to about 60 inches a year, and over the larger part of the Great Basin is considerably greater, amounting in places possibly to 150 inches.

An arid climate, however, has not always prevailed in this region. In late geologic time (early Quarternary) the bordering high mountains supported glaciers, and enormous lakes (the old shore lines of which are now plainly marked on the sides of many valleys) accumulated in the Great Basin. The two largest of these lakes have been named after early explorers. Lake Bonneville occupied a considerable part of western Utah, its shrunken remnants being represented by Sevier, Utah, and Great Salt lakes; and Lake Lahontan covered an immense area in western Nevada.

The chief rivers of the Great Basin rise in the mountains, which form its eastern and western borders, and receive their principal supply from melting snow. The nature of the discharge is characteristic, the maximum commonly occurs in late spring or early summer, after which the flow decreases to a minimum during the winter months. Upon leaving the mountains little or no increment is added to the streams. In the broad, waste-filled valleys they diminish in size, due to evaporation and seepage, and often entirely cease to flow. The following is a brief description of the chief streams of the Great Basin:

Bear River has its source on the northern slope of the Uinta Mountains in the northeastern part of Utah, and after a circuitous course, in which it leaves Utah and enters Wyoming, reenters Utah, appears again in Wyoming, makes a long detour in Idaho, reenters Utah, and finally discharges its waters into Great Salt Lake. Considerable irrigation is practiced on certain portions of the river. Logan River joins it in Cache Valley, Utah.

Weber River rises in the high country east of the Wasatch Mountains. Passing through that range, it appears in the plains region in the vicinity of Ogden, where, after receiving the water of Ogden River, it discharges into Great Salt Lake. There are a number of good reservoir sites on its upper tributaries, some of which recently have been utilized.

City, Parleys, Emigration, Mill, and Big and Little Cottonwood creeks enter Salt Lake Valley from the Wasatch Mountains and are tributary to Jordan River. Their watersheds are small, but the creeks

in the mountain courses maintain perennial flows. On reaching the main valley they are extensively used for irrigation, and the first three furnish the chief water supply for Salt Lake City.

American Fork and Hobble creeks are small streams, tributary to Utah Lake, and Spanish Fork River, next after Provo River, is the most important feeder of Utah Lake.

Provo River rises on the western slope of the Uinta Mountains and after receiving a number of tributaries enters what is known as Heber Valley, where considerable irrigation is practiced. After crossing this valley it passes through the Wasatch Mountains in a picturesque canyon, and finally enters Utah Valley, where its summer flow is completely diverted for irrigation purposes. Its flood waters discharge into Utah Lake.

Sevier River drains a large area in the southwestern part of Utah. It flows northerly until it enters Juab County, then makes a short bend and flows southwest into Sevier Lake. San Pitch River joins Sevier River near Gunnison, Utah.

Humboldt River rises in the extreme northeastern part of Nevada, and flowing across the structural features of the country in a general westerly and southerly direction, finally enters Humboldt Lake, whence its waters find their way into the Humboldt Sink. The tributaries follow the general direction of the mountain ranges, and flow either to the north or to the south. During low stages the water of the river is almost wholly diverted. For the future development of the country recourse must be had to the construction of storage reservoirs. Of its tributaries the North Fork enters it west of Peko, Nev., and the South Fork enters it about 10 miles below Elko, Nev. Pine Creek is a tributary from the south and joins it near Palisade, Nev. Marys River is one of its headwater tributaries.

Walker River is formed by two branches which have their sources in California, but unite in Nevada. It flows north and then takes a sharp bend to the southeast, emptying into Walker Lake.

Carson River has its source on the slopes of the Sierra Nevada in eastern California and flowing northward enters the State of Nevada. The East and West forks unite near Genoa, Nev., in upper Carson Valley. At Empire, 3 miles east of Carson, it turns to the northeast and enters a deep canyon, through which it flows for several miles, emerging into a second smaller valley a short distance above the town of Dayton. After leaving this valley it passes through two other shorter canyons and through one rather large valley before entering lower Carson Valley, or Carson Sink Valley, as it is also known, and discharges its waters into the Carson Sink.

The Truckee has its source on the slopes of the Sierra Nevada, in eastern California, and flows northward, entering Lake Tahoe, which is at an elevation of 6,225 feet and is the largest body of fresh water

in the United States at this considerable altitude. The area of the lake is 193 square miles. Its outlet is at Tahoe, Cal., from which point Truckee River has a general northward and eastward course, receiving several important tributaries which contribute to its flow. It drains into Pyramid and Winnemucca lakes, which have no outlets. Donner and Prosser creeks are tributaries of Truckee River. Independence Creek discharges into the Little Truckee, a main branch of Truckee River, entering it at Boca, Cal. They drain areas of 31.5 and 8.5 square miles, respectively, lying to the northwest of Lake Tahoe, in California.

Susan River has its source in the Sierra Nevada, in northeastern California, and flowing eastward discharges into Honey Lake—one of the land-locked lakes of the Great Basin—of which it is the principal feeder. A considerable area of land is irrigated from the waters of the river below the gaging station, and during the last ten or twelve years several projects have been started for irrigating other extensive areas by the storage of its waters both above and below the town of Susanville.

BEAR LAKE AT FISHHAVEN, IDAHO.

This station was established October 5, 1903, by W. P. Hardesty. It is located at Fishhaven, Idaho, on the west shore of Bear Lake, about 4 miles north of the Idaho-Utah State line. A plain staff gage, graduated to feet and tenths, is driven vertically into the bed of the lake 10 feet east of a crib where water from a spring rises to the surface. The gage is protected by 2 by 4 inch stakes driven on either side. The spring melts the ice before the regular spring break-up, and the shore at this point is comparatively free from the effects of the ice breaking up, while only a few hundred feet away the ice is piled up in great grinding masses during the breaking-up season. The gage is located on land used as a summer resort, owned by G. C. Gray, of Montpelier, Idaho, and is immediately south of the summer resort known as "Nelson's camp." The gage is read by John L. Nelson when the surface of the lake is calm. An extreme high-water mark pointed out by the observer, who has lived here thirty-three years, indicates that twenty or thirty years ago the surface of the lake was at approximately gage height 6.5 feet. A more definite mark shows a gage height of 6 feet as occurring twenty years ago. Bench mark No. 1 is a wooden hub driven flush with the ground, 1 foot south of a 15-inch cottonwood tree, 1 foot east of fence on east side of the county road, 142 feet north of the gage and about 18° to the west. Its elevation is 12.19 feet above the zero of the gage. Bench mark No. 2 is a shoulder cut on an above-ground root of a 20-inch cottonwood tree 2 feet southeast of the southeast corner of the porch of house on the summer resort grounds. It bears 81° west 93 feet south of the gage

rod. Its elevation is 7.13 feet above the zero of the gage. By readings on the lake surface here and at the north end of the lake, October 5, 1903, the elevation of the zero of the gage was found to be 12.26 by the datum used on canal surveys, etc., during 1903. This elevation is probably correct to within 0.05 foot. The elevation above sea level is approximately 6,000 feet.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Mean daily gage height, in feet, of Bear Lake at Fishhaven, Idaho, for 1903.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1				17			
2		2.50		18			
3				19			
4			2.15	20			
5	2.20	2.50		21		2.10	
6		2.05		22	2.10		
7				23			
8				24			2.10
9				25			
10				26			
11				27			
12	2.05			28			
13				29		2.05	
14		2.07	2.15	30	2.07		
15				31			2.10
16							

Mean daily gage height, in feet, of Bear Lake at Fishhaven, Idaho, for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.35	2.00		2.60	17	2.45	2.20		2.70	2.50
2		2.35	2.00		2.55	18	2.45	2.20			2.50
3		2.30	2.00		2.55	19	2.42	2.15		2.65	2.50
4		2.30	2.00		2.55	20	2.40	2.15		2.65	2.50
5		2.30	2.00		2.55	21	2.40	2.15		2.65	2.50
6		2.30	2.00		2.55	22	2.40	2.15		2.65	
7		2.30	2.00		2.55	23	2.40	2.10		2.65	
8		2.30	2.00	2.80		24	2.40	2.10		2.65	
9		2.25		2.80		25	2.40	2.10		2.60	2.50
10		2.25				26	2.40	2.10		2.60	2.50
11		2.25		2.75	2.50	27	2.40	2.05		2.60	2.50
12		2.25		2.75	2.50	28	2.40	2.05		2.60	
13		2.25		2.75	2.50	29	2.40	2.00		2.60	
14	2.45	2.20		2.70	2.50	30	2.40	2.00		2.60	
15	2.45	2.20		2.70	2.50	31	2.35				
16	2.45	2.20		2.70							

BEAR RIVER AT DINGLE, IDAHO.

This station was established May 9, 1903, by G. L. Swendsen. It is located in the cut made by the Oregon Short Line Railroad, one-fourth mile east of the railroad station at Dingle. The station is 250 feet south of the railroad track. The original gage was a vertical wooden rod bolted to an iron rod which was driven into the bed of the stream. It was replaced April 15, 1904, by a new vertical gage graduated to feet and tenths, from 2.5 feet to 10 feet. The zero of the new gage is at the same elevation as that of the old gage, which is 6,015.3 feet above the datum of the Oregon Short Line Railroad levels and 56.54 feet above the datum of the survey for the Bear Lake reservoir project made during the summer of 1903. The gage is read once each day by M. K. Hopkins. Discharge measurements are made by means of a cable and car. The cable has a total span of 151 feet. The initial point for soundings is the zero mark, 8 feet from the end of the cable at the north bank. The channel is straight for 400 feet above and below the station. The velocity is moderate at ordinary stages and is well distributed. Both banks are high, not liable to overflow, and cleared of everything except some small brush. The bed of the stream is composed of gravel, and there is but one channel at all stages. Bench mark No. 1 is a United States Geological Survey standard iron bench-mark post, bearing N. 33° 15′ E. 37 feet from the north end of the cable. Its elevation is 15.59 feet above the zero of the gage. Bench mark No. 2 is the top of the south post of the cable. Its elevation is 18.04 feet above the zero of the gage. Bench mark No. 3 is the top of a 4-foot stick of timber planted 2.7 feet in the ground. Its elevation is 18.42 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Bear River at Dingle, Idaho, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 3[a]	W. P. Hardesty	522	2.01	6.50	1,05
April 13	do	340	2.64	5.28	89
May 8	C. Tanner	518	3.89	6.73	2,0
June 7	H. S. Kleinschmidt	572	4.63	7.40	2,65
June 28	do	435	3.21	6.04	1,39
August 10	C. Tanner	191	1.41	3.90	27
November 7	W. Swendsen	194	1.39	3.95	27
December 20[b]	C. Tanner	149	1.65	3.93	24

[a] River frozen at gage. [b] Stream nearly frozen over.

Mean daily gage height, in feet, of Bear River at Dingle, Idaho, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a]3.60	4.10	6.40	5.40	6.00	7.90	5.60	4.15	4.00	3.90	4.00	4.20
2	3.70	4.10	6.50	4.90	6.00	7.90	5.60	4.10	4.00	3.85	4.00	4.00
3	3.70	4.10	7.00	4.90	6.10	7.95	5.50	4.00	4.00	3.85	4.00	4.00
4	3.80	4.20	6.60	4.70	6.20	8.00	5.50	4.00	4.00	3.80	4.00	4.50
5	3.80	4.20	6.30	4.80	6.30	7.90	5.50	4.00	4.00	3.80	4.00	4.10
6	3.80	4.20	5.80	4.90	6.50	7.60	5.50	4.00	4.00	3.80	4.00	4.60
7	3.80	4.20	5.40	5.10	6.70	7.40	5.50	3.95	4.00	.....	3.95	4.30
8	3.90	4.20	5.50	5.20	6.80	7.30	5.40	3.90	4.00	3.85	3.95	3.90
9	3.80	4.20	4.90	5.10	6.60	7.20	5.40	3.90	4.00	3.90	3.95	4.20
10	3.90	4.20	5.10	5.10	6.60	7.10	5.30	3.90	3.95	3.90	3.95	3.90
11	3.90	4.20	5.20	5.10	6.60	7.00	5.20	3.90	3.90	3.90	3.90	4.10
12	3.90	4.20	5.80	5.20	6.60	6.90	5.15	3.90	3.90	4.00	3.90	4.20
13	3.90	4.20	5.50	5.40	6.60	6.85	5.10	4.10	3.90	4.00	4.00	4.10
14	4.00	4.20	5.30	5.50	6.60	6.70	5.10	4.10	3.90	4.00	4.10	3.90
15	4.00	4.20	5.00	5.80	6.70	6.60	5.00	3.90	3.90	.....	3.60	3.90
16	4.00	4.20	5.20	6.00	6.90	6.60	5.00	3.90	3.90	4.00	4.30	3.90
17	4.00	4.20	4.90	6.10	6.95	6.80	4.90	4.00	3.90	4.00	4.50	4.30
18	4.00	4.20	4.80	6.00	7.00	6.80	4.80	4.00	3.90	4.00	4.00	4.10
19	4.00	4.20	4.90	5.90	7.20	6.80	4.75	4.00	3.90	4.00	4.00	3.90
20	4.00	4.20	4.90	5.90	7.30	6.70	4.70	4.00	3.90	4.00	3.80	4.10
21	4.00	4.20	5.00	5.90	7.40	6.60	4.70	4.00	3.90	4.00	3.80	4.00
22	4.00	4.20	5.20	5.95	7.50	6.60	4.60	4.10	3.90	4.00	4.30	3.90
23	4.00	4.40	5.40	5.90	7.70	6.55	4.40	4.10	3.90	4.00	4.40	4.10
24	4.00	4.40	5.60	5.80	7.75	6.50	4.40	4.20	3.90	4.00	4.80	3.90
25	4.00	4.40	.....	5.70	7.80	6.40	4.35	4.40	3.90	4.00	4.30	4.00
26	4.00	4.60	5.20	5.70	7.90	6.20	4.30	4.20	3.90	4.00	4.60	4.00
27	4.00	4.80	5.10	5.80	8.00	6.20	4.25	4.10	3.90	4.00	4.00	[b]4.30
28	4.00	5.70	4.80	5.90	8.00	6.05	4.30	4.00	3.90	4.00	4.20	5.40
29	4.00	6.75	4.70	5.90	7.90	5.90	4.20	4.00	3.90	4.00	4.40	5.20
30	4.10	.....	4.70	6.00	7.90	5.75	4.20	.....	3.90	4.00	4.40	5.30
31	4.10	.....	5.00	.....	7.90	.....	4.20	4.00	.....	4.00	.....	4.70

[a] River frozen from Jan. 1 to Mar. 7. Gage read to surface of ice. Above gage heights have been corrected for ice conditions before applying the rating table.

[b] Gage heights December 27–31 are too high owing to ice conditions. Have been corrected to 4.0 feet in getting discharge.

Rating table for Bear River at Dingle, Idaho, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	60	4.20	370	5.30	895	6.40	1,730
3.20	75	4.30	410	5.40	955	6.60	1,910
3.30	90	4.40	455	5.50	1,020	6.80	2,090
3.40	110	4.50	495	5.60	1,085	7.00	2,275
3.50	135	4.60	540	5.70	1,155	7.20	2,455
3.60	160	4.70	590	5.80	1,230	7.40	2,635
3.70	190	4.80	635	5.90	1,300	7.60	2,815
3.80	225	4.90	685	6.00	1,375	7.80	2,995
3.90	260	5.00	740	6.10	1,460	8.00	3,175
4.00	295	5.10	790	6.20	1,550		
4.10	330	5.20	840	6.30	1,640		

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1903 and 1904. It is well defined between gage heights 3.50 feet and 7.40 feet. The table has been extended beyond these limits. Above gage height 6.10 feet the rating curve is a tangent, the difference being 90 per tenth.

Estimated monthly discharge of Bear River at Dingle, Idaho, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	110	60	87.3	5,3[illegible]
February	590	110	215	12,[illegible]
March	1,230	590	854	52,5[illegible]
April	1,460	590	1,059	63,0[illegible]
May	3,175	1,375	2,302	141,5[illegible]
June	3,175	1,190	2,177	129,5[illegible]
July	1,085	370	711	43,7[illegible]
August	455	260	305	18,7[illegible]
September	295	260	271	16,1[illegible]
October	295	225	277	17,0[illegible]
November	635	160	339	20,1[illegible]
December	540	260	322	19,8[illegible]
The year	3,175	60	743	539,9[illegible]

BEAR RIVER NEAR PRESTON, IDAHO.

This station, established October 11, 1889, is about 6 miles from Preston, Idaho, and 10 miles north of the Utah-Idaho boundary line. The station is of considerable importance from the fact that its location is near the Utah-Idaho line, and the measurements there will indicate the volume of water that passes from Idaho into Utah. During 1901 a large canal was completed, appropriating the waters of Bear River about 8 miles below Soda Springs in sufficient quantity to irrigate about 35,000 acres of very fine land in that locality. The original gage consisted of a vertical board nailed to a pile of the highway bridge. This was carried away June 30, 1899, but was replaced on August 4 by a wire gage. It is read by J. A. Nelson. Discharge measurements are made by means of a cable and car. The initial point for soundings is the post over which the cable passes on the right bank. The channel is straight for 250 feet above and below the station. Both banks are high, clean, and not liable to overflow. The bed of the stream is smooth, and there is but one channel at low water. The bench mark for the readings of 1903 is that of the old gage, which is a nail in the southeast corner of a house near the gage, about 1.5 feet from the ground and 10.95 feet above gage datum. Because of some difficulty in maintaining the wire gage, a temporary gage was nailed to the pile of the highway bridge above the station. The readings of this gage have been reduced to the same datum as the wire gage. On October 31, 1903, a new gage was nailed to a pile on the highway bridge above the station. Its elevation is 10.80 feet below the old bench mark, therefore the gage heights from November 1 to December 31, 1903, have been increased 0.15 foot.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Bear River near Preston, Idaho, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 7	W. Swendsen	1,182	4.03	4.65	4,757
June 9	do	1,013	4.42	4.70	4,448
July 6	W. D. Beers	571	2.60	2.58	1,482
November 5	W. Swendsen	374	1.92	1.55	718
December 18	C. Tanner	391	1.68	1.60	733

Mean daily gage height, in feet, of Bear River near Preston, Idaho, for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	1.25	1.35	1.90	2.70	3.75	4.95	2.90	1.15	1.40	1.35	1.57	1.4
2	1.25	1.35	1.85	2.70	3.75	4.95	2.70	1.15	1.40	1.35	1.55	1.5
3	1.25	1.35	2.05	2.75	3.87	5.00	2.52	1.15	1.37	1.37	1.55	1.4
4	1.25	1.35	2.20	2.80	4.20	4.95	2.47	1.10	1.35	1.40	1.55	1.4
5	1.25	1.35	2.55	2.85	4.20	4.95	2.45	1.10	1.35	1.40	1.55	1.4
6	1.25	1.35	2.55	2.95	4.25	4.90	2.45	1.05	1.35	1.40	1.55	1.5
7	1.25	1.35	2.55	2.95	4.25	4.90	2.40	1.05	1.35	1.40	1.55	1.4
8	1.25	1.35	2.85	2.95	4.27	4.72	2.35	1.00	1.30	1.40	1.55	1.4
9	1.25	1.35	2.85	2.97	4.30	4.65	2.35	1.00	1.30	1.40	1.55	1.4
10	1.25	1.35	2.87	3.20	4.30	4.57	2.32	.95	1.30	1.40	1.55	1.5
11	1.25	1.35	2.85	3.35	4.30	4.52	2.32	.95	1.30	1.40	1.55	1.5
12	1.25	1.35	2.35	3.50	4.30	4.47	2.27	.95	1.25	1.45	1.55	1.4
13	1.25	1.35	2.35	3.70	4.30	4.40	2.25	.95	1.25	1.45	1.55	1.4
14	1.25	1.35	2.35	3.90	4.35	4.20	2.25	.95	1.25	1.45	1.55	1.4
15	1.25	1.45	2.55	4.12	4.35	4.10	2.15	.95	1.25	1.45	1.55	1.4
16	1.25	1.45	2.55	4.16	4.35	3.95	2.15	.95	1.25	1.55	1.55	1.4
17	1.25	1.50	2.55	4.16	4.35	3.87	2.07	1.00	1.25	1.60	1.55	1.5
18	1.35	1.55	2.70	4.15	4.35	3.80	2.00	1.15	1.25	1.60	1.50	1.5
19	1.35	1.55	3.05	4.10	4.40	3.72	1.92	1.15	1.25	1.60	1.50	1.5
20	1.35	1.55	3.20	4.16	4.45	3.65	1.85	1.15	1.25	1.60	1.50	1.5
21	1.35	1.55	2.90	4.20	4.45	3.57	1.77	1.15	1.25	1.60	1.45	1.5
22	1.35	1.65	2.87	4.15	4.57	3.55	1.67	1.15	1.25	1.60	1.45	1.6
23	1.35	2.40	2.85	4.15	4.62	3.55	1.62	1.15	1.25	1.60	1.45	1.4
24	1.35	1.95	2.85	4.07	4.67	3.55	1.55	1.25	1.25	1.60	1.45	1.4
25	1.35	2.10	2.85	3.95	4.72	3.47	1.47	1.30	1.25	1.60	1.45	1.4
26	1.35	2.35	2.85	3.87	4.75	3.45	1.45	1.35	1.25	1.60	1.45	1.4
27	1.35	2.25	2.85	3.85	4.77	3.40	1.40	1.35	1.32	1.60	1.45	1.5
28	1.35	2.05	2.85	3.85	4.82	3.35	1.40	1.37	1.35	1.60	1.45	1.4
29	1.35	2.05	2.85	3.80	4.85	3.27	1.40	1.45	1.35	1.60	1.45	1.4
30	1.35	.....	2.85	3.75	4.92	3.10	1.40	1.45	1.35	1.60	1.45	1.4
31	1.35	.....	2.85	.....	4.95	.....	1.40	1.42	.....	1.60	.....	1.5

[a] Gage heights estimated January 1 to February 5, as river was frozen.

Rating table for Bear River near Preston, Idaho, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.95	483	1.90	905	2.90	1,845	3.90	3,245
1.00	500	2.00	970	3.00	1,970	4.00	3,400
1.10	535	2.10	1,040	3.10	2,100	4.10	3,555
1.20	570	2.20	1,115	3.20	2,235	4.20	3,715
1.30	610	2.30	1,200	3.30	2,370	4.30	3,875
1.40	650	2.40	1,295	3.40	2,510	4.40	4,035
1.50	695	2.50	1,395	3.50	2,650	4.60	4,365
1.60	740	2.60	1,500	3.60	2,795	4.80	4,705
1.70	790	2.70	1,610	3.70	2,945	5.00	5,050
1.80	845	2.80	1,725	3.80	3,095		

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined, owing to lack of sufficient measurements.

Estimated monthly discharge of Bear River near Preston, Idaho, for 1904.

[Drainage area, 4,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	630	590	608	37,380	0.135	0.156
February	1,295	630	765	44,000	.170	.183
March	2,235	875	1,584	97,400	.352	.406
April	3,715	1,610	2,824	168,000	.628	.701
May	4,963	3,020	4,063	249,800	.903	1.04
June	5,050	2,100	3,621	215,500	.805	.898
July	1,845	650	1,041	64,010	.231	.266
August	672	483	550	33,820	.122	.141
September	650	590	609	36,240	.135	.151
October	740	630	697	42,860	.155	.179
November	727	672	700	41,650	.156	.174
December	740	659	680	41,810	.151	.174
The year	5,050	483	1,478	1,072,000	.329	4.47

BEAR RIVER NEAR COLLINSTON, UTAH.

This station was established July 1, 1889, by Samuel Fortier. It is located about 4 miles from the railroad station at Collinston, 2 miles east of Fielding, Utah, and below the headworks of the Bear River canal. The gage is a vertical iron rod graduated to tenths of a foot. There is also an iron gage fastened in a hole drilled in bed rock for low-water readings. The gage is read by D. A. Cannon. Discharge measurements are now made one-fourth mile above the gage from the bridge carrying the water-supply pipe of the Utah Light and Power Company. The section is only fair for high-water measurements, but good for low water. The right bank is high and sloping. The left bank is a steep cliff about 100 feet high, composed of gravel. The bed of the stream is solid rock covered with small stones. The bench mark is a nail in an oak post 20 feet west of the gage and 20 feet north of the cable at which discharge measurements were formerly taken. Its elevation is 7.35 feet above gage datum.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Bear River near Collinston, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet*
January 29	C. Tanner	216	2.92	1.37	[illegible]
March 5	W. P. Hardesty	434	5.06	2.70	[illegible]
May 10	C. Tanner	801	7.72	5.43	[illegible]
June 8	W. Swendsen	700	7.51	5.33	[illegible]
July 7	W. D. Beers	418	4.30	2.57	[illegible]
August 14	C. Tanner	139	1.80	.80	[illegible]
December 16	do	346	2.57	1.96	[illegible]

Mean daily gage height, in feet, of Bear River near Collinston, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	1.40	2.70	3.70	4.90	5.50	3.10	0.90	1.50	1.60	1.80	[illegible]
2	1.40	1.40	2.70	3.60	5.00	5.50	3.00	.90	1.40	1.60	1.80	[illegible]
3	1.50	1.40	2.70	3.50	5.00	5.50	2.90	.90	1.30	1.50	1.80	[illegible]
4	1.50	1.50	2.70	3.50	5.00	5.60	2.70	.90	1.30	1.50	1.90	[illegible]
5	1.50	1.50	2.70	3.40	5.30	5.60	2.60	.90	1.20	1.50	1.90	[illegible]
6	1.50	1.50	2.80	3.40	5.40	5.50	2.60	.90	1.20	1.50	1.90	[illegible]
7	1.50	1.50	2.90	3.50	5.30	5.50	2.50	.80	1.10	1.50	1.90	[illegible]
8	1.50	1.50	3.20	3.50	5.50	5.40	2.50	.80	1.10	1.50	1.90	[illegible]
9	1.50	1.50	3.90	3.40	5.30	5.30	2.50	.80	1.00	1.60	1.80	[illegible]
10	1.40	1.50	4.10	3.50	5.30	5.20	2.40	.80	1.10	1.60	1.80	[illegible]
11	1.30	1.40	3.90	3.60	5.30	5.10	2.30	.80	1.10	1.70	1.80	[illegible]
12	1.40	1.40	3.40	3.90	5.40	5.10	2.20	.80	1.00	1.70	1.90	[illegible]
13	1.40	1.50	3.20	4.20	5.50	5.00	2.10	.80	1.00	1.70	1.90	[illegible]
14	1.40	1.60	3.00	4.30	5.40	4.90	2.00	.80	1.10	1.80	1.90	[illegible]
15	1.40	1.60	3.00	4.50	5.50	4.80	1.90	.80	1.20	1.70	1.80	[illegible]
16	1.40	1.60	3.00	4.80	5.60	4.70	1.80	.80	1.20	1.80	1.80	[illegible]
17	1.50	1.80	3.10	5.00	5.60	4.50	1.70	.80	1.30	1.80	1.90	[illegible]
18	1.40	1.90	3.10	5.10	5.60	4.40	1.70	.90	1.20	1.80	1.90	[illegible]
19	1.40	1.80	3.50	5.00	5.50	4.30	1.70	1.10	1.30	1.90	1.90	[illegible]
20	1.40	1.70	3.90	5.10	5.50	4.20	1.60	1.20	1.30	1.90	1.90	[illegible]
21	1.40	1.50	4.10	5.20	5.50	4.10	1.50	1.10	1.30	1.90	1.9	[illegible]
22	1.40	1.80	4.00	5.40	5.50	4.00	1.40	1.00	1.30	1.90	1.80	[illegible]
23	1.40	2.90	3.70	5.30	5.60	3.90	1.30	1.00	1.30	1.90	1.80	[illegible]
24	1.40	4.00	3.70	5.20	5.60	3.80	1.20	1.10	1.40	1.90	1.80	[illegible]
25	1.40	4.20	3.70	5.20	5.70	3.80	1.10	1.20	1.40	1.90	1.80	[illegible]
26	1.30	4.20	3.50	5.10	5.70	3.60	1.20	1.30	1.50	1.90	1.80	[illegible]
27	1.30	4.10	3.30	5.00	5.70	3.50	1.10	1.40	1.50	1.90	1.70	[illegible]
28	1.30	3.40	3.40	4.90	5.70	3.40	1.00	1.40	1.50	1.80	1.80	[illegible]
29	1.40	2.90	3.60	5.00	5.60	3.20	.90	1.50	1.60	1.90	1.90	[illegible]
30	1.40	.....	3.80	5.00	5.50	3.20	.90	1.60	1.60	1.80	1.90	[illegible]
31	1.40	.....	3.80	.....	5.50	.....	.90	1.50	.....	1.80	.....	[illegible]

Rating table for Bear River near Collinston, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage heights.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	270	2.10	1,330	3.40	3,250	4.70	5,200
.90	300	2.20	1,470	3.50	3,400	4.80	5,350
1.00	340	2.30	1,610	3.60	3,550	4.90	5,500
1.10	390	2.40	1,750	3.70	3,700	5.00	5,650
1.20	450	2.50	1,900	3.80	3,850	5.10	5,800
1.30	520	2.60	2,050	3.90	4,000	5.20	5,950
1.40	600	2.70	2,200	4.00	4,150	5.30	6,100
1.50	680	2.80	2,350	4.10	4,300	5.40	6,250
1.60	760	2.90	2,500	4.20	4,450	5.50	6,400
1.70	860	3.00	2,650	4.30	4,600	5.60	6,550
1.80	970	3.10	2,800	4.40	4,750	5.70	6,700
1.90	1,080	3.20	2,950	4.50	4,900		
2.00	1,200	3.30	3,100	4.60	5,050		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined owing to poor conditions at station

Estimated monthly discharge of Bear River near Collinston, Utah, for 1904.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	680	520	610	37,510	0.102	0.118
February	4,450	600	1,443	83,000	.240	.259
March	4,300	2,200	3,187	196,000	.531	.612
April	6,250	3,250	4,740	282,000	.790	.881
May	6,700	5,500	6,303	387,600	1.05	1.21
June	6,550	2,950	5,055	300,800	.842	.939
July	2,800	300	1,207	74,220	.201	.232
August	760	270	376	23,120	.063	.073
September	760	340	514	30,580	.086	.096
October	1,080	680	908	55,830	.151	.174
November	1,080	860	1,021	60,750	.170	.190
December	1,200	760	1,067	65,610	.178	.205
The year	6,700	270	2,203	1,597,000	.367	4.99

LOGAN RIVER NEAR LOGAN, UTAH.

The station on Logan River was established June 1, 1896, about 2 miles east of Logan, Utah. The original equipment consisted of a cable and car and two gages. One gage was a vertical iron post set in the bed of the stream, and the other a vertical wooden gage near the above. The bench mark for both gages is a stone marked "B. M., 35 ft." northwest of the wooden gage. Its elevation is 14.01 feet above gage datum. The station was discontinued July 18, 1903. It was reestablished April 13, 1904, along the canyon road, 50 feet below the bridge over the river at the mouth of the canyon, and 800 feet below Hercules power house. The gage is a steel rod, graduated to feet and tenths, driven into the bed of the stream. The upstream edge is rounded or drawn to an edge. Observations are taken by the Hercules Power Company. Discharge measurements are made by means of a cable and car. The initial point for soundings is a 4 by 4 inch post set in the west bank of the river about 3 feet below the cable line. The channel is straight for 150 feet above and 75 feet below the station. The current is swift. Both banks are high, rocky, and covered with small brush. The bed of the stream is composed of cement gravel and bowlders. When the station was reestablished in 1904 the channel was improved by removing large bowlders and other material, to distribute the flow throughout the cross section. During the spring flood new material was deposited, and still remains in a loose state. There is but one channel at all stages. The bench mark is a United States Geological Survey standard metallic plug cemented in a solid limestone ledge. Its elevation is 24.85 feet above the zero of the gage, and 4,[illegible] feet above sea level.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Logan River near Logan, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 23	W. Swendsen	91	4.62	5.10	[illegible]
April 25	do	93	4.42	5.00	[illegible]
May 4	do	111	5.02	5.50	[illegible]
May 5	do	128	5.22	5.70	[illegible]
May 9	do	127	5.32	5.70	[illegible]
May 11	do	127	5.31	5.70	[illegible]
May 17	do	152	6.07	6.20	[illegible]
June 4	do	157	6.43	6.25	1,0[illegible]
July 3	W. D. Beers	129	5.71	5.50	[illegible]
August 15	C. Tanner	72	3.41	4.70	[illegible]
November 3	W. Swendsen	57	3.05	4.60	[illegible]
December 17	C. Tanner	50	2.95	4.40	[illegible]

Mean daily gage height, in feet, of Logan River near Logan, Utah, for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.50	6.50	5.60	4.90	4.60	4.50	4.55	4.45
2	.....	5.40	6.45	5.60	4.85	4.60	4.60	4.55	4.45
3	.....	5.50	6.35	5.55	4.85	4.60	4.60	4.55	4.45
4	.....	5.55	6.10	5.55	4.80	4.60	4.60	4.55	4.45
5	.....	5.55	6.35	5.50	4.80	4.60	4.60	4.55	4.45
6	.....	5.50	6.20	5.50	4.80	4.65	4.60	4.55	4.45
7	.....	5.70	6.15	5.45	4.80	4.65	4.60	4.55	4.45
8	.....	5.70	6.10	5.40	4.80	4.65	4.60	4.55	4.45
9	.....	5.70	6.05	5.40	4.80	4.65	4.60	4.55	4.45
10	.....	5.80	6.10	5.35	4.80	4.65	4.70	4.50	4.48
11	.....	5.90	6.15	5.30	4.80	4.60	4.60	4.50	4.45
12	.....	5.90	6.10	5.40	4.80	4.60	4.60	4.50	4.48
13	.....	6.00	6.10	5.30	4.80	4.60	4.60	4.50	4.48
14	.....	6.00	6.15	5.30	4.80	4.50	4.60	4.50	4.48
15	.....	6.20	6.15	5.20	4.75	4.60	4.60	4.50	4.48
16	.....	6.20	6.20	5.20	4.75	4.60	4.60	4.50	4.48
17	.....	6.20	6.15	5.20	4.80	4.60	4.60	4.55	4.48
18	.....	6.30	6.20	5.15	4.75	4.60	4.60	4.55	4.48
19	.....	6.30	6.25	5.10	4.75	4.60	4.60	4.55	4.48
20	.....	6.40	6.20	5.05	4.70	4.60	4.60	4.50	4.48
21	.....	6.40	6.10	5.05	4.70	4.70	4.60	4.50	4.48
22	.....	6.40	6.00	5.00	4.70	4.80	4.60	4.45	4.48
23	.....	6.60	6.00	5.00	4.70	4.80	4.60	4.45	4.48
24	.....	6.95	5.90	5.00	4.70	4.85	4.55	4.45	4.48
25	5.00	6.60	5.80	5.00	4.60	4.80	4.55	4.45	4.48
26	5.10	6.40	5.80	5.00	4.60	4.80	4.55	4.45	4.48
27	5.10	6.30	5.70	5.00	4.60	4.75	4.55	4.45	4.48
28	5.20	6.20	5.70	4.90	4.70	4.60	4.55	4.45	4.48
29	5.10	6.30	5.75	4.90	4.70	4.50	4.55	4.45	4.48
30	5.50	6.40	5.60	4.90	4.70	4.50	4.55	4.45	4.48
31	.....	6.45	.....	4.90	4.60	.....	4.55	.....	4.48

Rating table for Logan River near Logan, Utah, from April 25 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.45	150	4.85	288	5.50	577	6.30	996
4.50	164	4.90	308	5.60	625	6.40	1,052
4.55	179	4.95	329	5.70	675	6.50	1,108
4.60	195	5.00	350	5.80	726	6.60	1,164
4.65	212	5.10	394	5.90	779	6.70	1,222
4.70	230	5.20	438	6.00	833	6.80	1,280
4.75	249	5.30	483	6.10	887	6.90	1,338
4.80	268	5.40	529	6.20	941		

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1904. It is fairly well defined between gage heights 4.40 feet and 6.25 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Logan River near Logan, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 25–30	577	350	424	5,046
May	1,367	529	878	53,980
June	1,108	625	876	52,130
July	625	308	448	27,55[illegible]
August	308	195	249	15,3[illegible]
September	288	164	211	12,5[illegible]
October	230	164	191	11,74[illegible]
November	179	150	167	9,9[illegible]
December	158	150	155	9,5[illegible]
The period				197,8[illegible]

Mean daily gage height, in feet, of Logan River, Hyde Park, and Smithfield canal, near Logan, Utah, for 1904.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	5.90	5.80	5.40	17	5.50	5.90	5.70	.....
2	.....	5.82	5.80	5.40	18	5.50	5.90	5.70	.....
3	.....	5.90	5.90	5.40	19	5.60	5.80	5.70	.....
4	.....	5.80	5.90	5.40	20	5.70	5.80	5.70	.....
5	5.35	5.80	5.80	5.50	21	5.70	5.90	5.70	.....
6	5.35	5.90	5.90	5.40	22	5.80	5.80	5.70	.....
7	5.35	5.80	5.80	5.40	23	5.80	5.90	5.60	.....
8	5.40	5.80	5.80	5.50	24	5.70	5.90	5.60	.....
9	.....	5.70	5.80	5.40	25	5.80	5.90	5.60	.....
10	5.25	5.80	5.80	5.40	26	5.90	5.90	5.60	.....
11	5.35	5.80	5.70	.....	27	5.70	5.80	5.60	.....
12	5.40	5.70	5.70	.....	28	5.70	5.90	5.50	.....
13	5.50	5.90	8.70	.....	29	5.80	5.80	5.50	.....
14	5.50	5.90	5.70	.....	30	5.80	5.80	5.50	.....
15	5.60	5.90	5.70	.....	31	.....	5.90	5.40	.....
16	5.60	5.90	5.70	.....					

BLACKSMITH FORK NEAR HYRUM, UTAH.

A gaging station was maintained near the tollgate near Hyrum, Utah, from July 19, 1900, to December 31, 1902.

A new station was established May 16, 1904, by W. G. Swendsen. It is located about 1,000 feet downstream from the tollgate at the mouth of the canyon, about 800 feet upstream from the city electric light plant at Hyrum, Utah. A plain staff gage, graduated to feet and tenths, is driven vertically into the bed of the stream and braced to the south bank. The gage is read daily by Uriah Benson. Discharge measurements are made by means of a cable and car. The initial point for soundings is the support at the south end of the cable. The channel is straight for 200 feet above and 50 feet below the station. The current is swift. The right bank for 20 feet back is a low wooded flat, which is subject to overflow during high water. The right bank is high and does not overflow. The bed of the stream is composed of cement, bowlders, and gravel, and is permanent. There is but one channel at all stages. The depth of the water during high stages is about 3 feet. Bench mark No. 1 is a United States Geological Survey metallic plug set in the limestone ledge with cement. Its elevation is 17.875 feet above the zero of the gage. Bench mark No. 2 is the top of the eyebolt of north cable anchor. Its elevation is 9.578 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Blacksmith Fork near Hyrum, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 16	W. Swendsen	116	5.05	5.20	578
June 4	do	73	4.19	4.40	305
July 4	W. D. Beers	57	3.34	3.90	191
August 15	C. Tanner	47	2.89	3.78	136
November 2	W. Swendsen	47	2.59	3.65	122
December 17	C. Tanner	38	2.31	3.56	88

Mean daily gage height, in feet, of Blacksmith Fork near Hyrum, Utah, for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	De
1	.....	4.35	4.00	3.80	3.80	3.70	3.65	
2	.....	4.35	3.90	3.80	3.70	3.70	3.65	
3	.....	4.35	3.90	3.80	3.70	3.70	3.65	
4	.....	4.40	3.90	3.80	3.70	3.70	3.65	
5	.....	4.40	3.90	3.80	3.70	3.70	3.65	
6	.....	4.40	3.90	3.80	3.70	3.70	3.60	
7	.....	4.40	3.90	3.80	3.70	3.70	3.60	
8	.....	4.40	3.90	3.80	3.70	3.70	3.60	
9	.....	4.40	3.90	3.80	3.70	3.70	3.60	
10	.....	4.30	3.90	3.80	3.70	3.70	3.60	
11	.....	4.20	3.90	3.80	3.70	3.70	3.60	
12	.....	4.20	3.90	3.80	3.70	3.80	3.60	
13	.....	4.20	3.90	3.80	3.70	3.80	3.60	
14	.....	4.20	3.90	3.80	3.70	3.80	3.60	
15	.....	4.10	3.90	3.80	3.70	3.80	3.60	
16	5.50	4.10	3.90	3.80	3.70	3.80	3.60	
17	5.50	4.00	3.80	3.80	3.70	3.80	3.60	
18	5.50	4.00	3.80	3.80	3.70	3.70	3.60	
19	5.50	4.10	3.80	3.80	3.70	3.70	3.60	
20	5.50	4.10	3.80	3.80	3.70	3.70	3.60	
21	5.50	4.10	3.80	3.80	3.70	3.70	3.60	
22	5.90	4.10	3.80	3.80	3.70	3.70	3.60	
23	5.00	4.10	3.80	4.00	3.70	3.70	3.60	
24	5.00	4.10	3.80	4.00	3.70	3.70	3.60	
25	4.30	4.00	3.80	4.00	3.70	3.70	3.60	
26	4.30	4.00	3.80	3.90	3.70	3.70	3.60	
27	4.30	4.00	3.80	3.90	3.70	3.70	3.60	
28	4.30	4.00	3.80	3.80	3.70	3.70	3.60	
29	4.30	4.00	3.80	3.80	3.70	2.70	3.60	
30	4.30	4.00	3.80	3.80	3.70	3.70	3.60	
31	4.30	.....	3.80	3.80	.....	3.70	.....	

Rating table for Blacksmith Fork near Hyrum, Utah, from May 16 to December 31, 19

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	80	4.10	215	4.80	438	5.50	6
3.50	88	4.20	244	4.90	474	5.60	7
3.60	105	4.30	273	5.00	510	5.70	772
3.70	122	4.40	305	5.10	546	5.80	8
3.80	140	4.50	337	5.20	581	5.90	8
3.90	160	4.60	370	5.30	618	6.00	8
4.00	186	4.70	403	5.40	656		

The above table is applicable only for open-channel conditions. It is based u 6 discharge measurements made during 1904. It is well defined between g heights 3.50 feet and 5.20 feet. The table has been extended beyond these li Above gage height 5.30 feet the rating curve is a tangent, the difference being per tenth.

Estimated monthly discharge of Blacksmith Fork near Hyrum, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 16–31	848	273	497	15,770
June	305	186	238	14,160
July	186	140	151	9,285
August	186	140	146	8,977
September	140	122	123	7,319
October	140	122	125	7,686
November	113	105	106	6,307
December	105	80	94.1	5,786
The period				75,290

BLACKSMITH FORK POWER PLANT RACE NEAR HYRUM, UTAH.

[Blacksmith Fork Aqueduct.]

This station was established May 16, 1904, by W. G. Swendsen. It is located about 600 feet down the canyon road from the tollgate at mouth of canyon, about 200 feet below the head of the canal or race, and about 500 feet south of the river station. The gage is an iron rod, graduated to feet and tenths, driven vertically into the bed of the stream and braced to a foot plank. It is read daily by Uriah Benson. Discharge measurements are made from the foot plank to which the gage is fastened. The initial point for soundings is a zero mark on the plank. The channel is straight for 100 feet above and 200 feet below the station. The current has a velocity of about 3½ feet per second. Both banks are high and composed of fine gravel. The bed of the stream is composed of fine gravel, and is apparently permanent. There is but one channel at all stages. Bench mark No. 1 is a point marked with red paint on a projecting rock of the foundation of rock house 400 feet northwest of the gage. Its elevation is 8.845 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Blacksmith Fork power plant race near Hyrum, Utah, in 190

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-ft.*
May 16	W. Swendsen	31	2.71	4.80	8
June 4	do	30	2.16	4.60	6
July 4	W. D. Beers	25	2.20	4.45	5
August 15	C. Tanner	24	2.52	4.47	6
November 2	W. Swendsen	21	2.44	4.35	5
December 17	C. Tanner	20	1.96	4.30	3

Mean daily gage height, in feet, of Blacksmith Fork power plant race near Hyrum, Utah, for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.70	4.40	4.50	4.50	4.30	4.30	4.
2	.....	4.70	4.40	4.50	4.40	4.30	4.30	4.
3	.....	4.70	4.50	4.50	4.40	4.30	4.30	4.
4	.....	4.60	4.50	4.50	4.40	4.30	4.30	4.
5	.....	4.60	4.50	4.40	4.40	4.30	4.30	4.
6	.....	4.60	4.50	4.40	4.40	4.30	4.30	4.
7	.....	4.60	4.50	4.50	4.40	4.30	4.30	4.
8	.....	4.60	4.50	4.50	4.40	4.30	4.30	4.
9	.....	4.60	4.50	4.50	4.40	4.30	4.30	4.
10	.....	4.40	4.50	4.50	4.40	4.30	4.30	4
11	.....	4.60	4.50	4.50	4.40	4.30	4.30	4.
12	.....	4.50	4.50	4.50	4.40	4.40	4.30	4.
13	.....	4.50	4.50	4.50	4.40	4.40	4.30	4.
14	.....	4.50	4.50	4.50	4.40	4.40	4.30	4.
15	.....	4.60	4.50	4.50	4.40	4.40	4.30	4.
16	4.80	4.60	4.50	4.50	4.40	4.40	4.30	4.
17	4.80	4.50	4.50	4.50	4.40	4.40	4.30	4.
18	4.80	4.50	4.50	4.50	4.40	4.30	4.30	4
19	4.80	4.50	4.50	4.50	4.40	4.30	4.30	4.
20	4.80	4.50	4.50	4.50	4.40	4.30	4.30	4.
21	4.80	4.50	4.50	4.50	4.40	4.30	4.30	4.
22	4.70	4.50	4.50	4.50	4.40	4.30	4.30	4.
23	4.70	4.50	4.50	4.50	4.40	4.30	4.30	4.
24	4.90	4.50	4.50	4.50	4.40	4.30	4.30	4
25	4.90	4.40	4.50	4.50	4.40	4.30	4.30	4.
26	4.70	4.40	4.50	4.50	4.40	4.30	4.30	4
27	4.70	4.40	4.50	4.50	4.40	4.30	4.30	4.
28	4.60	4.40	4.50	4.50	4.40	4.30	4.30	4.
29	4.70	4.40	4.50	4.50	4.40	4.30	4.30	4.
30	4.70	4.40	4.50	4.50	4.40	4.30	4.30	4.
31	4.70	.....	4.50	4.50	.....	4.30	.....	4.

Rating table for Blacksmith Fork power plant race near Hyrum, Utah, from May 16 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.30	42	4.50	59	4.70	76	4.90	93
4.40	50	4.60	68	4.80	85		

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined between gage heights 4.30 and 4.80 feet.

Estimated monthly discharge of Blacksmith Fork power plant race near Hyrum, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 16–31	93	68	81.0	2,571
June	76	50	61.3	3,648
July	59	50	58.4	3,591
August	59	50	58.4	3,591
September	59	50	50.3	2,993
October	50	42	43.5	2,675
November	42	42	42.0	2,499
December	59	33	46.4	2,853
The period				24,420

WEBER RIVER NEAR OAKLEY, UTAH.

This station was established October 22, 1904, by W. D. Beers. It is located 3 miles above Oakley, Utah, above all diversions to the Kamas prairie region. The station is about 200 feet south of the wagon road. The gage is composed of three sections of iron bar bolted in an inclined position to the limestone ledge at the left bank of the river. It is graduated to read direct to feet and tenths. The gage is read once each day by John Franson. Discharge measurements are made by means of a cable and car. The initial point for soundings is the anchor bolt at the left end of the cable. The channel is straight for 300 feet above, and 250 feet below the station. The current is very swift. The right bank is a low wooded bottom for 200 feet back and is liable to overflow slightly during very high water. The right bank is a high brush-covered ledge and is not subject to overflow. The bed of the stream is composed of coarse gravel

and cobblestones, which are liable to shift in high floods. There is but one channel at all stages, excepting a small depression which carries a small amount of water during very high floods. Flood velocities are very high, and it is necessary to use a suitable meter and a guy line. The bench mark is a United States Geological Survey bolt set in the limestone ledge about 0.5 foot from the initial point for soundings. Its elevation is 14.79 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Weber River near Oakley, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet*
October 22	W. D. Beers	57	1.50	4.27	86
December 13 [a]	do	105	1.00	5.55	107

[a] Measurement made through ice.

Mean daily gage height, in feet, of Weber River near Oakley, Utah, for 1904.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1		4.20	[a] 4.15	12		4.20	(a)	22		4.15	[a]
2		4.20	[a] 4.15	13		4.20	[a] 5.55	23	4.25	4.15	[a]
3		4.20	[a] 4.35	14		4.35	(a)	24	4.25	4.15	[a]
4		(a)	[a] 5.45	15		4.35	[a] 5.20	25	4.25	4.15	[a]
5		4.20	[a] 5.45	16		4.15	(a)	26	4.25	4.15	[a]
6		4.20	[a] 5.40	17		4.15	(a)	27	4.25	[a] 4.20	[a]
7		4.20	[a] 5.55	18		4.15	(a)	28	4.25	[a] 4.20	[a]
8		4.20	[a] 5.55	19		4.15	(a)	29	4.25	(a)	[a]
9		4.20	[a] 5.65	20		4.15	[b] 4.62	30	4.25	[a] 4.25	[a]
10		4.20	[a] 5.70	21		4.15	(a)	31	4.25		[a]
11		4.20	[a] 5.55								

[a] Ice. [b] Ice 11 inches thick.

CHALK CREEK AT COALVILLE, UTAH.

This station was established October 23, 1904, by W. D. Beers. It is located at the foot bridge on the main road leading north, one-eighth mile from the court-house at Coalville, Utah. A vertical staff gage, graduated to feet and tenths, is attached to a pile near the right bank of the stream. It is read once each day by Miss Eva Rees. Discharge measurements are made from the foot bridge at which the gage is located. The initial point for soundings is a point marked zero at the left end of the bridge. The channel is slightly curved and somewhat irregular for 150 feet above the station. A wagon bridge spans the stream 50 feet above. The channel below the station is somewhat

wider and straight for 100 feet. The tailrace of an old mill enters the stream 100 feet below the station. Both banks are high, nearly free from timber or brush, and not subject to overflow. The bed of the stream is composed of small cobblestones and is permanent. There is but one channel at all stages, which is broken at high stages by the pile supports of the bridge. The bridge crosses the stream at about 15° from right angle, and points for soundings were laid off longer to correspond to the cosine of angle. The bench mark is a cut on the south corner of the stone abutment of the wagon bridge. Its elevation is 0.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements on Chalk Creek at Coalville, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
October 24	W. D. Beers	26	0.76	1.50	20
December 12	do	24	.79	1.50	20

Mean daily gage height, in feet, of Chalk Creek at Coalville, Utah, for 1904.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	1.50	1.60	12	.....	1.25	1.50	22	.....	1.55	.....
2	.....	1.50	1.60	13	.....	1.47	1.50	23	1.50	1.45	1.50
3	.....	1.50	1.40	14	.....	1.40	.....	24	1.50	1.42	1.50
4	.....	1.50	1.30	15	.....	1.46	.....	25	1.50	1.55	.....
5	.....	1.50	1.30	16	.....	1.49	.....	26	1.50	1.55	.....
6	.....	1.50	1.47	17	.....	1.42	1.50	27	1.50	1.60	1.50
7	.....	1.40	1.55	18	.....	1.52	.....	28	1.50	1.55	.....
8	.....	1.43	1.40	19	.....	1.51	.....	29	1.50	1.35	.....
9	.....	1.47	1.40	20	.....	1.40	1.50	30	1.47	1.44	1.50
10	.....	1.43	1.50	21	.....	1.53	1.50	31	1.47	.....	1.50
11	.....	1.35	1.55								

JORDAN RIVER NEAR LEHI, UTAH.

This station was established May 30, 1904, by W. G. Swendsen. It is located at the highway bridge, about 800 feet below the pump house at the outlet of Utah Lake, near the town of Lehi, Utah. A staff gage, graduated to feet and tenths, is nailed vertically to a pier at the southeast corner of the bridge. It is read twice each day by W. A. Knight. Discharge measurements are made from a plank walk built across the stream upon cantilevers from the bridge to which the gage is attached. The initial point for soundings is two 10-penny nails driven close together in the east end of the plank. The channel is

straight for about 150 feet above and below the station. The current is sluggish. Both banks are high, clean, and not subject to overflow. The bed of the stream is composed of clay and is probably not permanent, since the channel may be cleaned or dredged out at any time by the canal company. Bench mark No. 1 is a nail in the top of pile at the east abutment of the bridge. Its elevation is 8.57 feet above the zero of the gage. Bench mark No. 2 is the head of the copper bolt of Utah Lake Compromise Monument. Its elevation is 10.50 feet above the zero of the gage.

There is practically no natural flow in Jordan River the greater part of the year, and in order to utilize the water of Utah Lake in irrigation work the water is raised by means of a dam and pumping station a short distance above the gaging station so as to make an artificial flow.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Jordan River near Lehi, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 28 [a]	W. Swendsen	252	1.62	3.95	4[illegible]
May 30 [a]	do	252	1.62	3.95	4[illegible]
June 14 [a]	H. S. Kleinschmidt	236	1.80	4.00	4[illegible]
June 20 [a]	do	237	1.80	4.00	4[illegible]
July 30 [a]	C. Tanner	245	1.68	3.92	4[illegible]
October 13 [b]	W. D. Beers and E. F. Tabor.	214	1.40	3.27	[illegible]
October 13 [b]	do	214	1.37	3.27	[illegible]
October 13 [c]	do	195	1.02	2.95	[illegible]
October 14 [d]	do	149	.76	2.02	[illegible]
October 14 [d]	do	146	.76	1.97	[illegible]
October 15 [b]	do	216	1.41	3.30	[illegible]
December 23	W. Swendsen	81	.38	1.01	[illegible]

[a] 4 pumps running.
[b] 3 pumps running.
[c] Measurement uncertain on account of change in cross section of stream
[d] 1 pump running.

Mean daily gage height, in feet, of Jordan River near Lehi, Utah, for 1904.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.10	3.95	3.95	3.85	3.35	0.80	0.90
2	.....	4.00	3.95	3.90	3.85	3.35	.80	.90
3	.....	4.05	3.95	(a)	3.85	3.30	.80	.90
4	.....	4.05	4.00	3.90	3.85	3.30	.80	.90
5	.....	4.00	3.95	3.90	3.85	3.35	.80	.90
6	.....	3.95	4.00	3.90	3.80	(a)	.80	.90
7	.....	4.05	3.95	3.67	3.85	(a)	.80	.90
8	.....	4.10	3.95	3.90	3.85	3.40	.80	.90
9	.....	3.95	3.95	3.90	3.85	3.35	.80	.90
10	.....	4.05	3.72	3.90	3.90	3.35	.85	.90
11	.....	4.05	3.95	3.90	3.80	3.30	.85	.90
12	.....	4.00	4.10	(a)	3.85	3.30	.85	.90
13	.....	4.00	4.00	(a)	3.90	3.35	.85	.90
14	.....	4.05	4.00	3.90	(a)	(b)	.85	.90
15	.....	4.00	4.00	3.85	3.85	.....	.85	.90
16	.....	3.95	3.90	3.90	3.85	.....	.85	.95
17	.....	4.00	3.95	3.90	3.80	.75	.85	.95
18	.....	3.95	3.95	3.85	3.75	.75	.90	.95
19	.....	3.70	3.95	3.85	3.85	.75	.90	.95
20	.....	3.95	3.90	3.95	3.80	.75	.90	1.00
21	.....	3.95	3.95	3.85	3.80	.75	.90	1.00
22	.....	4.05	4.00	3.85	3.75	.75	.90	1.00
23	.....	4.00	3.90	3.85	3.80	(b)	.90	1.00
24	.....	4.00	3.60	3.85	3.80	.....	.90	1.00
25	.....	4.00	(a)	3.85	3.80	.....	.90	1.00
26	.....	4.00	3.95	3.90	3.85	.....	.90	1.00
27	.....	4.00	3.95	3.85	3.90	.....	.90	1.00
28	.....	3.95	3.95	3.90	3.80	.....	.90	1.00
29	.....	4.00	4.00	3.75	3.80	.80	.90	1.00
30	3.95	3.95	3.90	3.85	3.40	.80	.90	1.00
31	3.95	.....	3.90	3.90	.....	.80	.....	1.15

a Discharge interpolated.

b Outlet gates shut down.

Rating table for Jordan River near Lehi, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	22	1.30	47	2.30	148	3.30	302
.75	23	1.40	55	2.40	161	3.40	320
.80	24	1.50	63	2.50	175	3.50	337
.85	25	1.60	71	2.60	189	3.60	354
.90	26	1.70	81	2.70	204	3.70	371
.95	28	1.80	91	2.80	219	3.80	388
1.00	30	1.90	101	2.90	235	3.90	406
1.05	33	2.00	111	3.00	252	4.00	423
1.10	36	2.10	122	3.10	268	4.10	440
1.20	41	2.20	135	3.20	285	4.20	456

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904. It is well defined between gage heights 1.00 foot and 4.00 feet. The table has been extended beyond these limits. Above gage height 3.00 feet the rating curve is a tangent, the difference being 17 + per tenth.

Estimated monthly discharge of Jordan River near Lehi, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	414	250	304	18,684
June	440	371	422	25,1[illegible]
July	440	354	410	25,21[illegible]
August	414	367	402	24,7[illegible]
September	406	320	392	23,3[illegible]
October, 22 days	320	23	192	8,[illegible]
November	26	24	25.1	1,4[illegible]
December	38	26	28.1	1,7[illegible]
The period				128,[illegible]

Discharge, in acre-feet, of Jordan River and canal systems.

Month.	North Jordan.	East Jordan.	City.	South Jordan.	Utah and Salt Lake.	Jordan River weir.	Total [illegible] of river.
April [a]	0	650		647	720	75	2,09[illegible]
May	1,063	3,036	596	5,167	4,150	2,911	16,9[illegible]
June	3,061	5,701	452	6,648	7,878	4,225	27,9[illegible]
July	3,425	5,369	3,199	5,407	6,719	3,894	28,0[illegible]
August	3,367	5,186	3,090	5,031	7,110	3,668	27,45[illegible]
September	2,766	5,280	1,373	5,357	7,992	2,767	25,5[illegible]
October [b]	753	1,920	399	2,134	3,367	310	8,88[illegible]
Total	14,440	27,140	9,109	30,390	37,940	17,850	136,9[illegible]

[a] Flow started April 23.

[b] Pumps were shut down October 15.

AMERICAN FORK NEAR AMERICAN FORK, UTAH.

This station was established May 21, 1900, by C. C. Babb. It is located about 6 miles northeast of the town of American Fork, Utah, 50 feet north of the county road, and 200 feet southwest of the power house of the electrical company. Measurements are made over a sharp crested, rectangular weir. A nail driven into the weir structure, just south of the south opening and level with the crest of the weir, serves to determine gage heights. The observer is Peter Anderson. During floods considerable gravel runs in the stream and is deposited just above the weir, making measurement at such times erroneous. When this difficulty becomes pronounced, several planks in the dam are raised and the gravel is sluiced out.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Mean daily gage height, in feet, of American Fork near American Fork, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.27	.....	0.27	.....	0.88	.....	1.05	0.58	0.46	0.48	0.46	0.41
2	.27	0.28	.27	.....	.82	.....	1.04	.58	.45	.47	.45	.41
3	.27	.28	.27	0.35	.78	.....	1.02	.58	.45	.47	.45	.40
4	.27	.28	.27	.35	.83	.....	1.00	.57	.44	.47	.44	.40
5	.27	.27	.27	.35	87	.....	.98	.56	.44	.47	.44	.36
6	.27	.28	.26	.36	.95	.....	.96	.55	.44	.48	.44	.37
7	.28	.27	27	.36	1 00	.....	.94	.53	.44	.48	.44	.37
8	.28	27	30	.37	1 01	.....	.90	.53	.43	.48	.44	.37
9	.28	.27	.32	.38	.99	.....	.87	.53	.43	.48	.44	.37
10	.28	.27	32	.....	1.09	.....	.87	.53	.43	.47	.44	.37
11	.28	.27	32	.....	1.19	.....	.83	.53	.43	.47	.44	.37
12	.28	.27	.31	.....	1.22	.....	.83	.53	.43	.53	.44	.37
13	.29	.27	.31	.....	1 25	.....	.80	.60	.43	.49	.43	.38
14	.29	.27	.31	.....	1.28	1.22	.78	.56	.43	.51	.42	.39
15	.....	.27	.31	.....	1 30	1.17	.78	.56	.42	.50	.41	.40
16	.29	.27	.31	.....	1.44	1.22	.73	.56	.42	.50	.42	.40
17	.29	.27	.....	.....	1.42	1.24	.74	.56	.42	.50	.41	.38
18	.29	.27	.32	.....	1.45	1.22	.69	.55	.42	.49	.41	.38
19	.29	.27	.32	.....	1.48	1.22	.68	.53	.42	.49	.41	.39
20	.29	.27	.32	.....	1.39	1.24	.67	.53	.46	.47	.41	.39
21	.29	.27	.33	.....	1.24	1.17	.66	.51	.47	.47	.41	.39
22	.29	.27	.33	.....	1.30	1.16	.66	.48	.47	.47	.41	.40
23	.29	.28	.32	.....	1.39	1.09	.65	.47	.47	.47	.41	.40
24	.....	.28	.32	.60	1.71	1.03	.64	.48	.47	.47	.41	.40
25	.27	.28	.32	.62	2.01	.97	.63	.48	.48	.47	.41	.39
26	.27	.28	.32	.65	.....	.99	.61	.48	.49	.47	.41	.36
27	.28	.28	.32	.68	.....	1.03	.61	.48	.49	.47	.41	.30
28	.28	.28	.....	.74	.....	1.05	.61	.48	.49	.47	.41	.38
29	.28	.28	.37	.80	.....	1.04	.62	.48	.49	.46	.41	.38
30	.28	.....	.37	.86	.....	1.05	.61	.47	.48	.46	.41	.39
31	.28	.....	.36	.....	.....	.....	.61	.47	.....	.46	.....	.39

NOTE.—Total width of weir, April 15 to September 20 = 42 feet (10 end contractions). Remainder of year = 33 feet (10 end contractions).

Mean daily discharge, in second-feet, of American Fork near American Fork, Utah, for 190[illegible].

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	15	a16	15	a23	113	a310	147	61	43	36	34	[illegible]
2	15	16	15	a23	102	a301	145	61	42	35	33	[illegible]
3	15	16	15	23	95	a291	141	61	42	35	33	[illegible]
4	15	16	15	23	104	a281	137	59	40	35	32	[illegible]
5	15	15	15	23	111	a271	133	58	40	35	32	[illegible]
6	15	16	15	23	127	a261	129	56	40	36	32	[illegible]
7	16	15	15	23	137	a252	125	53	40	36	32	[illegible]
8	16	15	18	24	139	a242	117	53	39	36	32	[illegible]
9	16	15	20	25	135	a232	111	53	39	36	32	[illegible]
10	16	15	20	a28	155	a222	111	53	39	35	32	[illegible]
11	16	15	20	a30	176	a212	104	53	39	35	32	[illegible]
12	16	15	19	a33	183	a203	104	52	39	41	32	[illegible]
13	17	15	19	a35	190	193	98	64	39	37	31	[illegible]
14	17	15	19	a38	196	183	95	58	39	39	30	[illegible]
15	a17	a15	19	a41	201	172	95	58	38	38	28	[illegible]
16	17	15	19	a43	233	183	86	58	38	38	30	[illegible]
17	17	15	a19	a46	229	187	87	58	38	38	28	[illegible]
18	17	15	20	a48	236	183	79	56	38	37	28	[illegible]
19	17	15	20	a51	243	183	77	53	38	37	28	[illegible]
20	17	15	20	a54	222	187	75	53	34	35	28	[illegible]
21	17	15	21	a56	187	172	74	50	35	35	28	[illegible]
22	17	15	21	a59	201	170	74	46	35	35	28	[illegible]
23	17	16	20	a61	222	155	72	44	35	35	28	[illegible]
24	a16	16	20	64	299	143	71	46	35	35	28	[illegible]
25	15	16	20	67	379	131	69	46	36	35	28	[illegible]
26	15	16	20	72	a369	135	66	46	37	35	28	[illegible]
27	16	16	20	77	a359	143	66	46	37	35	28	[illegible]
28	16	16	a22	87	a350	147	66	46	37	35	28	[illegible]
29	16	16	24	98	a340	145	67	46	37	34	28	[illegible]
30	16	.....	24	109	a330	147	66	44	36	34	28	[illegible]
31	16	.....	23	.....	a320	.....	66	44	.....	34	.....	[illegible]

a Discharge estimated.

Estimated monthly discharge of American Fork near American Fork, Utah, for 190[illegible].

[Drainage area, 66 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 6–30	111	27	52.7	2,613	.798	[illegible]
May	208	69	122	7,501	1.85	[illegible]
June	280	133	213	12,670	3.23	[illegible]
July	125	42	73.2	4,501	1.11	[illegible]
August	43	27	34.5	2,121	.523	[illegible]
September	33	26	27.9	1,660	.423	[illegible]
October	34	22	26.4	1,623	.400	[illegible]
November	25	20	21.4	1,273	.324	[illegible]
December	21	16	18.6	1,144	.282	[illegible]
The Period	.....	.....	.....	35,110	.....	.....

NOTE.—Missing gage heights interpolated.

Estimated monthly discharge of American Fork near American Fork, Utah, for 1904.

[Drainage area, 66 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.			Rainfall in inches.[a]
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.	Per cent of rainfall.	
January	17	15	16.1	990	0.244	0.281	14.7	1.91
February	18	15	15.4	886	.233	.251	9.5	2.64
March	24	15	19.1	1,174	.289	.333	9.2	3.62
April	109	23	46.9	2,791	.711	.793	63	1.26
May	379	95	216	13,280	3.27	3.77	183	2.06
June	310	131	201	11,960	3.05	3.40	596	.57
July	147	66	95.3	5,860	1.44	1.66	488	.34
August	64	44	52.8	3,247	.800	.922	140	.66
September	43	35	38.1	2,267	.577	.644	644	.10
October	41	34	35.9	2,207	.544	.627	45.1	1.39
November	34	28	30.0	1,785	.454	.507	.....	.00
December	28	18	25.3	1,556	.383	.442	29.8	1.48
The year	379	15	66.0	48,000	1.00	13.62	85.0	16.03

[a] Mean at Provo and Heber.

PROVO RIVER AT MOUTH OF CANYON, NEAR PROVO, UTAH.

This station was established July 27, 1889, by Samuel Fortier. It is located about 6 miles north of Provo, about 1,000 feet above Olmsted Station, on the Denver and Rio Grande Railroad, and 1,200 feet above the power house of the Telluride Power Company, and above the head of most of the irrigation canals of Utah Valley. The diversion works of the company, which develop power at the mouth of Provo Canyon for electric transmission to the mines west of Provo, are located about 5 miles above the station. The Heber branch of the Denver and Rio Grande Railway passes within 20 feet of the new gage rod. The station is one-eighth mile above the county bridge. The old gage is an inclined rod set on the left bank. The new gage is a vertical aspen stick set on the right bank 90 feet northeast of the old gage. Both gages read 4.80 feet when the new gage was installed, but the zero of the new gage is 0.10 foot above the zero of the old gage. During 1904 the gage was read twice each day by E. A. Briscoe. Discharge measurements are made by means of a cable and car located at the gage. Instead of using a tagged wire, the cable has been marked with white paint every 3 feet. The initial point for soundings is the first white

mark on the cable south of the vertical post which supports the cable on the right bank. The channel is straight for 200 feet above and for 100 feet below the station. The right bank is steep and rocky and has an elevation of about 10 feet above the zero of the gage. The left bank is sloping and has an elevation of about 7 feet above the zero of the gage. It is liable to overflow at flood stages. The bed of the stream is composed of bowlders and is permanent. The current is swift, and at flood stages has a velocity that is too high for accurate measurement. There is one channel up to the point where the river overflows the left bank. Above this stage there are two channels. Bench mark No. 1 is a cross chiseled in a limestone rock about 1 foot square, which bears south 15° E. and is 100 feet distant from the old gage. Its elevation is 6.98 feet above the zero of the old (inclined) gage. The letters "B. M." are chiseled in the rock. Bench mark No. 2 is a United States Geological Survey standard bench mark plate cemented into the top of the south abutment of the highway bridge one-eighth mile southwest of the station. Its elevation is 4.75 feet above the zero of the gage. Bench mark No. 3 bears north 7° 45′ west 126 feet from the north post of the station. It is a cross chiseled on top of a bowlder projecting about 1 foot above the ground. Its elevation is 11.21 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Provo River at mouth of canyon, near Provo, Utah, in 190

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
January 5	C. Tanner	115	2.48	4.50	28
February 10	do	93	2.07	4.22	19
March 12	do	132	2.72	4.65	35
March 23	W. P. Hardesty	128	3.09	4.70	39
April 16	C. Tanner	170	3.63	5.15	61
May 19	do	253	5.50	6.25	1,3
June 15	H. S. Kleinschmidt	251	5.37	6.25	1,3
June 18	do	200	5.27	5.70	1,0
July 12	do	95	2.50	4.30	2
July 12	do	101	2.47	4.30	2
July 26	do	81	2.31	4.04	1
October 31	W. Swendsen	76	2.06	4.00	1
December 7	do	52	1.76	3.92	9
December 20	do	61	1.79	3.98	10

Mean daily gage height, in feet, of Provo River at mouth of canyon, near Provo, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.40	4.55	4.73	4.71	a 4.88	6.30	4.59	4.09	3.99	3.74	3.98	4.12
2	4.40	4.40	4.81	4.66	4.87	6.28	4.53	4.02	4.02	3.70	3.97	4.20
3	4.40	4.40	4.75	4.70	4.95	6.58	4.48	4.00	4.08	3.76	4.00	4.02
4	4.40	4.40	4.63	4.77	5.17	6.30	4.43	4.00	4.01	3.78	3.98	4.05
5	4.40	4.45	4.65	4.71	4.97	6.33	4.46	4.03	3.99	3.84	3.95	4.00
6	4.40	a 4.45	a 4.65	4.68	4.99	6.22	4.54	4.00	4.02	3.80	3.96	3.90
7	4.40	a 4.40	4.66	4.66	5.00	6.09	4.47	4.03	3.99	3.85	3.94	3.95
8	4.40	4.40	4.73	4.65	5.04	6.36	4.47	4.01	4.01	3.80	3.90	4.00
9	4.40	4.45	4.96	4.67	5.09	6.43	4.27	4.07	4.00	3.89	3.97	3.95
10	4.40	4.40	4.79	4.69	5.39	6.46	4.28	4.01	3.98	3.94	3.98	4.00
11	4.40	4.46	4.84	4.79	5.53	6.49	4.23	4.01	4.00	3.82	3.95	4.02
12	4.45	4.51	4.65	4.89	5.64	6.54	4.21	4.04	3.99	3.90	3.92	4.10
13	4.47	4.52	4.61	4.95	5.69	6.51	4.18	4.04	4.18	3.86	3.99	4.10
14	4.50	4.49	4.60	5.07	5.74	6.51	4.18	4.07	3.73	3.86	4.02	4.08
15	4.30	4.49	4.69	5.10	5.84	6.29	4.02	4.17	3.74	3.90	4.00	4.09
16	4.30	4.62	4.67	5.17	5.92	6.00	4.13	4.16	3.71	4.00	4.00	4.10
17	a 4.32	4.65	4.63	5.00	5.98	5.97	4.12	4.11	3.77	4.04	4.00	4.10
18	4.35	4.53	4.64	5.07	6.15	5.84	4.00	4.10	3.83	3.92	4.17	4.00
19	4.22	4.52	4.64	5.02	6.37	a 4.84	4.10	4.09	3.81	3.96	4.00	4.02
20	4.27	4.56	4.71	5.25	6.21	5.85	4.09	4.11	3.85	3.90	4.10	3.95
21	4.22	4.59	4.69	5.24	6.15	5.81	4.11	4.08	3.89	3.97	4.00	4.00
22	4.30	4.70	4.63	5.10	6.25	5.60	4.11	4.05	3.86	3.92	4.00	4.10
23	4.30	5.28	4.65	5.05	6.44	5.40	4.09	4.03	3.89	3.92	4.01	4.11
24	4.45	5.29	4.67	4.88	6.80	5.23	4.25	4.00	3.89	3.97	4.00	4.12
25	4.45	5.53	4.67	4.95	7.26	5.12	4.18	4.05	a 3.89	3.95	4.05	4.10
26	4.35	5.38	4.64	4.93	7.23	5.01	4.10	4.05	3.89	3.96	4.07	3.98
27	4.40	4.97	4.60	4.96	7.13	4.96	4.07	4.03	3 96	3.95	4.10	4.05
28	4.35	4.90	4.62	5.03	6.86	4.85	4.21	4.03	3.85	3.97	4.20	4.08
29	4.40	4.77	5.23	5.01	6.49	4.77	4.06	4.08	3.75	3.97	4.05	3.98
30	4.40	.....	5.02	4.98	6.40	4.69	4.07	4.05	3.71	3.96	4.05	3.92
31	4.40	.....	4.83	.....	6.35	.....	4.02	3.99	.....	3.94	.....	4.25

a Interpolated.

Rating table for Provo River at mouth of canyon, near Provo, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	68	4.30	220	5.40	775	6.40	1,490
3.65	73	4.40	253	5.50	841	6.50	1,565
3.70	79	4.50	290	5.60	910	6.60	1,640
3.75	86	4.60	331	5.70	980	6.70	1,715
3.80	94	4.70	376	5.80	1,050	6.80	1,790
3.85	103	4.80	425	5.90	1,120	6.90	1,865
3.90	113	4.90	477	6.00	1,192	7.00	1,945
3.95	124	5.00	532	6.10	1,265	7.10	2,025
4.00	136	5.10	589	6.20	1,340	7.20	2,105
4.10	162	5.20	649	6.30	1,415	7.30	2,185
4.20	190	5.30	711				

The above table is applicable only for open-channel conditions. It is based upon 17 discharge measurements made during 1903 and 1904. It is well defined between gage heights 4 feet and 6.25 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Provo River at mouth of canyon near Provo, Utah, for 1904.

[Drainage area, 640 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.			Rainfall in inches.
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.	Per cent of rainfall.	
January	290	196	244	15,000	0.381	0.439	23	1.91
February	861	253	373	21,460	.583	.629	24	2.6[illegible]
March	667	331	388	23,860	.606	.699	19	3.[illegible]2
April	680	353	486	28,920	.759	.847	67	1.2[illegible]
May	2,153	461	1,145	70,410	1.79	2.06	100	2.0[illegible]
June	1,625	371	1,131	67,300	1.77	1.98	347	.57
July	326	136	202	12,420	.316	.364	107	.34
August	182	134	149	9,162	.233	.269	41	.66
September	184	80	117	6,962	.183	.204	204	.10
October	146	79	113	6,948	.177	.204	15	1.3[illegible]
November	190	113	139	8,271	.217	.242	.....	0.0[illegible]
December	205	113	149	9,162	.233	.269	18	1.4[illegible]
The year	2,153	79	386	279,900	.604	8.20	51	16.0[illegible]

[a] Mean at Provo and Heber.

Estimated monthly discharge of Telluride Power Company's flume near Provo, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 15–31[a]	65	0	42.7	1,440
June	85	20	38.5	2,291
July	76	0	53.9	3,314
August	82	36	61.1	3,75[illegible]
September	90	32	58.4	3,475
October	81	58	71.6	4,40[illegible]
November	77	48	63.0	3,749
December	81	31	56.0	3,44[illegible]
The period	.....	.....	.....	25,8[illegible]

[a] Flow began May 15.

NOTE.—To get total flow of Provo River at head of diversion dams, the flume discharge should be added to that of the gaging station given above.

PROVO RIVER AT SAN PEDRO, LOS ANGELES AND SALT LAKE RAILROAD BRIDGE, NEAR PROVO, UTAH.

This station was established May 24, 1903, by C. Tanner. It is located at the San Pedro, Los Angeles and Salt Lake Railroad bridge, one-half mile from Provo, Utah. The Rio Grande Western Railway bridge is about 300 feet east of the station. The gage is a vertical rod fastened to a cottonwood post, which is set in the bed of the river near the left or south bank. The top of the post is spiked to a stringer of the bridge. The gage is read once each day by Lars Thomson. Discharge measurements at high water are made from the railroad bridge, to which the gage is attached. At low stages measurements are made by wading. The initial point for soundings is the north face of the left or south abutment. The channel is straight for 175 feet above and for 300 feet below the station. The current is swift. There are two channels at low water and one channel at high water. Both banks have an elevation of about 8 feet above the river bed, and will overflow only at extreme flood stages. The bed of the stream is composed of gravel and cobblestones and is somewhat shifting. Bench mark No. 1 is a United States Geological Survey standard bench mark set in cement on the top of the south abutment of the bridge, to which the gage is attached. Its elevation is 6.68 feet above the zero of the gage. Bench mark No. 2 is a cross cut in the top of the parapet wall of the south abutment of the Denver and Rio Grande Railroad bridge, 275 feet upstream from the gaging station. Its elevation is 11.26 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Provo River at S. P., L. A. and S. L. R. R. bridge, near Provo, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per sec.*	*Feet.*	*Second-feet.*
January 15	C. Tanner	49	2.97	0.96	146
February 12	do	75	2.55	1.06	190
February 23	do	136	3.63	1.75	493
March 13	do	78	3.36	1.20	263
March 24	W. P. Hardesty	80	3.39	1.32	271
April 25	C. Tanner	99	3.82	1.50	380
May 21	W. Swendsen	156	5.11	2.19	795
June 2	do	230	4.45	2.42	1,026
June 15	H. S. Kleinschmidt	172	4.72	2.35	810
June 18	do	156	4.56	2.08	703
October 31	W. Swendsen	21	3.04	—.10	65
December 3	do	40	2.47	.40	99
December 21	do	45	3.42	.75	153

Mean daily gage height, in feet, of Provo River at S. P., L. A. and S. L. R. R. bridge, near Provo, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	0.92	0.93	1.36	1.36	1.42	2.6
2	.....	.....	1.38	1.32	1.40	2.60
3	.....	1.04	1.30	1.30	1.46	2.70
4	.....	.....	1.28	1.34	1.44	2.30
5	.92	1.08	1.26	1.36	1.40	2.30
6	.....	.....	1.24	1.32	1.48	2.20
7	.....	1.04	1.30	1.30	1.54	2.50
8	.....	.....	1.30	1.34	1.50	2.50
9	.90	1.02	1.32	1.26	1.52	2.40
10	.....	.....	1.32	1.30	1.60	2.42
11	1.00	1.08	1.38	1.30	1.70	2.50
12	.....	1.06	1.30	1.40	1.96	2.60
13	.....	.....	1.28	1.40	2.00	2.54
14	.99	.98	1.22	1.44	2.10	2.45
15	1.00	.....	1.24	1.54	2.16	2.30
16	.....	1.38	1.20	1.50	2.24	2.20
17	.....	1.37	1.20	1.52	2.24	2.20
18	1.00	1.08	1.30	1.44	2.30	2.00
19	.....	1.08	1.32	1.46	2.40	1.96
20	1.00	1.10	1.30	1.50	2.40	1.84
21	.....	1.14	1.34	1.54	2.36	1.64
22	1.00	1.42	1.38	1.50	2.34	1.60
23	.....	1.80	1.32	1.52	2.50	1.50
24	.94	1.68	1.36	1.48	2.90	1.46
25	.....	2.10	1.36	1.50	3.20	1.40
26	.97	1.50	1.38	1.58	3.26	1.40
27	.....	1.36	1.36	1.70	3.30	.80
28	.96	1.22	1.34	1.74	3.00	(a)
29	.....	1.39	1.64	1.70	2.70	.....
30	1.10	.....	1.50	1.40	2.66	.....
31	.....	.....	1.40	.....	2.50	.....

a Stream dry.

Rating table for Provo River at S. P., L. A. and S. L. R. R. bridge, near Provo, Utah, from January 1 to June 5, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	130	1.60	433	2.20	805	2.80	1,247
1.00	160	1.70	488	2.30	879	2.90	1,321
1.10	196	1.80	544	2.40	953	3.00	1,395
1.20	235	1.90	605	2.50	1,027	3.10	1,469
1.30	279	2.00	667	2.60	1,100	3.20	1,543
1.40	328	2.10	731	2.70	1,173	3.30	1,617
1.50	380						

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during January to June 5, 1904. It is well defined between gage heights 0.90 foot and 2.20 feet. The table has been extended beyond these limits. Above gage heights 2.20 feet the rating curve is a tangent, the difference being 74 per tenth.

Rating table for Provo River at S. P., L. A. and S. L. R. R. bridge near Provo, Utah, from June 6 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	65	0.70	144	1.40	414	2.10	708
0.10	70	0.80	170	1.50	456	2.20	750
0.20	78	0.90	204	1.60	498	2.30	792
0.30	87	1.00	246	1.70	540	2.40	834
0.40	96	1.10	288	1.80	582	2.50	876
0.50	108	1.20	330	1.90	624	2.60	918
0.60	123	1.30	372	2.00	666	2.70	960

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during June to December, 1904. It is well defined between gage heights 0.10 foot and 2.60 feet. The table has been extended beyond these limits. Above gage height 0.90 foot the rating curve is a tangent, the difference being 42 per tenth.

Estimated monthly discharge of Provo River at S. P., L. A. and S. L. R. R. bridge near Provo, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January [a]	196	130	146	8,977
February [a]	731	139	253	14,550
March	455	235	294	18,080
April	510	279	353	21,000
May	1,617	328	810	49,800
June 1–28 [b]	1,173	0	653	38,860
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	.....	.....	.....	[c] 1,782
November	.....	.....	.....	4,990
December	.....	.....	.....	8,494
The year	.....	.....	.....	166,500

[a] Discharge interpolated for missing gage heights.
[b] Stream dry June 28 to October 15.
[c] Estimated October 15, when flow began, to December 31 from meter measurements.

HOBBLE CREEK NEAR SPRINGVILLE, UTAH.

This station was established March 23, 1904, by C. Tanner. It is located about 1 mile above the mouth of the canyon, about 4 miles southeast of Springville, Utah. It is about 600 feet northeast of the head of the Mapleton canal and about 1,200 feet southwest of the power house of the Springville Electric Lighting plant. A staff gage, graduated to feet and tenths, is driven into the bed of the stream and braced to an overhanging tree. It is read daily by F. N. West. Discharge measurements are made by wading near the gage. The initial point for soundings is a 2 by 4 inch post driven into the south bank, marked with pencil. At 24.3 feet on the north bank a tree is blazed and marked "24.3." The channel is straight for 75 feet above and 50 feet below the station. The current is fairly swift. The right bank is low, wooded, and liable to overflow during high water. The right bank is high and wooded. The bed of the stream is composed of clean sand and gravel and is somewhat shifting. There is but one channel at all stages. Bench mark No. 1 is a nail in the top of the post which marks the initial point for soundings. Its elevation is 4.91 feet above the zero of the gage. Bench mark No. 2 is a nail in a post set 26 feet south of the initial point for soundings. Its elevation is 12.38 feet above the zero of the gage. Bench mark No. 3 is a 30-penny nail in the east side of a pole of the electric transmission line 97 feet northwest of the initial point for soundings. Its elevation is 21.80 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Hobble Creek near Springville, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 18	C. Tanner	17	1.13	1.26	20
March 28	W. P. Hardesty	20	1.24	1.34	25
April 18	E. C. Murphy and C. Tanner.	42	2.80	2.90	117
May 20	C. Tanner	35	3.30	2.85	114
May 20	W. Swendsen	36	3.72	2.85	124
June 1	do	21	3.80	2.05	78
June 17	H. S. Kleinschmidt	19	3.53	1.85	68
July 19	do	10	2.17	1.40	23
September 15	C. Tanner	7.7	1.78	1.27	14
September 15	do	9	1.60	1.27	15
October 30	W. Swendsen	12	1.46	1.35	17
December 2	do	10	1.23	1.32	13
December 21	do	9.7	1.75	1.35	17

Mean daily gage height, in feet, of Hobble Creek near Springville, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1	.....	1.75	3.00	2.15	(a)	17	.....	3.00	3.02	1.70	.....
2	.....	1.72	2.95	2.05	.....	18	.....	2.90	2.92	1.70	.....
3	.....	1.77	3.15	2.00	.....	19	.....	3.00	2.80	1.70	.....
4	.....	1.82	3.35	1.95	.....	20	.....	3.00	2.65	1.60	.....
5	.....	1.95	3.80	1.95	.....	21	.....	.....	2.55	1.65	.....
6	.....	1.90	4.10	1.90	.....	22	.....	2.70	.....	1.60	.....
7	.....	1.80	4.00	1.80	.....	23	1.57	2.50	2.70	1.50	.....
8	.....	1.85	3.75	1.70	.....	24	1.35	2.35	2.75	1.40	.....
9	.....	1.90	3.55	1.70	.....	25	1.45	2.35	2.80	1.30	.....
10	.....	2.00	3.40	1.70	.....	26	1.45	2.50	2.90	1.30	.....
11	.....	2.20	3.55	1.70	.....	27	1.50	2.90	2.85	1.25	.....
12	.....	2.60	3.45	1.65	.....	28	1.57	3.10	2.60	1.25	.....
13	.....	2.85	3.40	1.70	.....	29	1.82	3.00	2.45	1.25	.....
14	.....	3.20	3.35	1.75	.....	30	1.85	3.05	2.35	1.25	.....
15	.....	3.30	3.30	1.75	.....	31	1.79	.....	2.20	.....	.....
16	.....	3.30	3.20	1.70	.....						

a Observer discontinued gage reading.

Rating table for Hobble Creek near Springville, Utah, from January 1 to May 26, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	17	1.70	46	2.40	88	3.30	141
1.25	19	1.75	49	2.50	94	3.40	147
1.30	22	1.80	52	2.60	100	3.50	153
1.35	25	1.85	55	2.70	106	3.60	159
1.40	28	1.90	58	2.80	112	3.70	165
1.45	31	2.00	64	2.90	118	3.80	171
1.50	34	2.10	70	3.00	123	3.90	177
1.55	37	2.20	76	3.10	129	4.00	182
1.60	40	2.30	82	3.20	135	4.10	188
1.65	43						

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during March 18 to May 20, 1904. It is not well defined. The rating curve is a tangent, the difference being 6 per tenth. Indication of channel changing about May 26, 1904.

Rating table for Hobble Creek near Springville, Utah, from May 27 to November 26, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	5	1.80	59	2.40	113	2.90	158
1.30	14	1.90	68	2.50	122	3.00	167
1.40	23	2.00	77	2.60	131	3.10	176
1.50	32	2.10	86	2.70	140	3.20	185
1.60	41	2.20	95	2.80	149	3.30	194
1.70	50	2.30	104				

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during June 1 to December 21, 1904. It is not well defined. The rating curve is a tangent, the difference being 9 per tenth. Indication of channel changing about May 26, 1904.

Estimated monthly discharge of Hobble Creek near Springville, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	55	25	39.7	2,4[illegible]
April	141	47	93.9	5,5[illegible]
May	188	95	133	8,1[illegible]
June	90	10	45.8	2,7[illegible]
July[a]				1,[illegible]
August				1,2[illegible]
September				[illegible]
October				1,0[illegible]
November				[illegible]
December				[illegible]
The period				24,3[illegible]

[a] Observer on July 1 discontinued gage reading, and read depth of water in cross section. Discharge for July to December, inclusive, was estimated from meter measurements and the depth of water in section.

SPANISH FORK NEAR SPANISH FORK, UTAH.

This station was originally established May 23, 1900, by C. C. Babb. It was reestablished March 26, 1903, by C. Tanner. It is located 600 feet above the dam of the East Bench Irrigation Company and 5 miles southeast of Spanish Fork, Utah. The Rio Grande Western Railroad track is about 300 feet northeast of the gage. The gage is a 1 by 4 inch redwood stick 4½ feet long. It is driven firmly in the bed of the river and is well braced. It is graduated to feet, tenths, and fiftieths, and located near the right bank about 1 foot from the water's edge. It is read once each day by Levi Thorpe. Discharge measurements are made by wading. The initial point for soundings is a willow stake on the right bank 2 feet northeast of the gage. The channel is straight for 150 feet above and below the station and the current is swift. The right bank is about 4 feet above the bed of the stream. It is covered with a dense growth of willows and is not liable to overflow. The left bank is about 5½ feet above the bed of the stream. It is also covered with willows. The bed of the stream is composed of coarse gravel and sand, somewhat shifting. The change in the cross section takes place principally in the right half. There is but one channel at all stages. The bench mark is a cross on a limestone rock, which bears south 36° east, and is 29 feet distant from the gage. On the south face of the rock are the letters "U. S. G. S." in black paint. Its elevation is 7.16 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Spanish Fork near Spanish Fork, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 9	C. Tanner	28	2.40	1.50	66
March 14	do	28	2.62	1.54	75
March 26	W. P. Hardesty	30	2.61	1.58	79
April 18	C. Tanner	54	3.72	2.30	201
June 16	H. S. Kleinschmidt	42	3.31	1.88	142
July 20	do	32	3.23	1.50	102
September 15	C. Tanner	27	2.43	1.40	66
October 30	W. Swendsen	30	2.33	1.40	69
December 2	do	27	2.41	1.40	64
December 22	do	26	2.50	1.47	65

Mean daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.56	1.68	1.58	1.82	2.48	2.46	1.76	1.54	1.44	1.40	1.42	
2	1.64	1.70	1.58	1.80	2.48	2.36	1.70	1.50	1.44	1.40	1.42	
3	1.50	1.70	1.50	1.80	2.66	2.52	1.68	1.48	1.42	1.40	1.42	
4	1.46	1.50	1.58	2.30	2.76	2.44	1.70	1.44	1.42	1.40	1.42	
5	1.46	1.48	1.50	1.92	2.78	2.34	1.66	1.44	1.42	1.40	1.42	
6	1.46	1.50	1.54	1.82	3.01	2.26	1.64	1.42	1.40	1.40	1.42	
7	1.58	1.48	1.56	1.78	2.96	2.36	1.72	1.46	1.40	1.40	1.42	
8	1.70	1.58	1.60	1.80	2.94	2.30	1.68	1.40	1.40	1.40	1.42	
9	1.80	1.48	1.66	1.80	2.94	2.20	1.64	1.42	1.40	1.40	1.42	
10	1.80	1.50	1.50	1.90	3.00	2.08	1.66	1.42	1.40	1.42	1.42	
11	1.60	1.50	1.58	2.20	3.14	2.04	1.60	1.44	1.40	1.38	1.28	
12	1.54	1.50	1.54	2.12	3.22	2.02	1.60	1.54	1.40	1.42	1.26	
13	1.52	1.50	1.46	2.24	3.28	2.00	1.60	1.46	1.38	1.42	1.26	
14	1.58	1.42	1.54	2.24	3.28	1.96	1.56	1.58	1.38	1.42	1.24	
15	1.42	1.50	1.54	2.42	3.28	1.94	1.52	1.48	1.40	1.42	1.38	
16	1.42	1.52	1.56	2.26	3.36	1.92	1.54	1.48	1.42	1.42	1.36	
17	1.42	1.54	1.54	2.26	3.34	1.90	1.54	1.52	1.46	1.42	1.32	
18	1.48	1.50	1.54	2.32	3.32	1.90	1.52	1.48	1.42	[a] 1.41	1.38	
19	1.64	1.56	1.58	2.36	3.26	1.88	1.52	1.44	1.40	1.40	1.44	
20	1.44	1.48	1.56	2.44	3.14	1.84	1.52	1.44	1.38	1.40	1.32	
21	1.68	1.52	1.56	2.40	2.98	1.80	1.50	1.44	1.40	1.40	1.34	
22	1.50	1.56	1.46	2.24	2.96	1.76	1.50	1.44	1.40	1.40	1.34	
23	1.46	1.88	1.60	2.18	2.96	1.74	1.50	1.44	1.40	1.40	1.32	
24	1.46	1.78	1.60	2.10	2.96	1.72	1.68	1.46	1.40	1.40	1.30	
25	1.46	1.74	1.62	2.12	3.34	1.70	1.58	1.46	1.40	1.40	1.30	
26	1.56	1.70	1.46	2.10	3.30	1.70	1.52	1.44	1.40	1.42	1.32	
27	1.80	1.60	1.58	2.34	3.04	1.70	1.52	1.46	1.42	1.42	1.34	
28	1.64	1.72	1.60	2.40	2.90	1.70	1.60	1.50	1.42	1.42	1.34	
29	1.68	1.54	2.50	2.42	2.70	1.70	1.56	1.48	1.42	1.42	1.30	
30	1.48	.....	2.12	2.40	2.66	1.72	1.58	1.54	1.42	1.42	1.26	
31	1.68	.....	1.92	.....	2.54	.....	1.58	1.46	.....	1.42	.....	

[a] Interpolated.

Rating table for Spanish Fork near Spanish Fork, Utah, from January 1 to May 15, and from December 10 to December 31, 1904. [a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	36	1.60	82	2.00	146	2.80	300
1.25	40	1.65	89	2.10	164	2.90	320
1.30	45	1.70	97	2.20	183	3.00	340
1.35	50	1.75	105	2.30	202	3.10	361
1.40	56	1.80	113	2.40	221	3.20	382
1.45	62	1.85	121	2.50	240	3.30	403
1.50	68	1.90	129	2.60	260	3.40	424
1.55	75	1.95	137	2.70	280		

[a] Two rating tables necessary for 1904 on account of changes in channel during May and November.

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during spring and 1 measurement made in December, 1904. It is fairly well defined between gage heights 1.40 and 2.30 feet. The table has been extended beyond these limits.

Rating table for Spanish Fork near Spanish Fork, Utah, from May 17 to December 9, 1904.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	45	1.60	95	2.00	161	2.80	308
1.25	50	1.65	103	2.10	179	2.90	327
1.30	55	1.70	111	2.20	197	3.00	346
1.35	61	1.75	119	2.30	215	3.10	365
1.40	67	1.80	127	2.40	233	3.20	384
1.45	73	1.85	135	2.50	251	3.30	404
1.50	80	1.90	144	2.60	270	3.40	424
1.55	87	1.95	152	2.70	289		

[a] Two rating tables necessary for 1904 on account of changes in channel during May and November.

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during summer and fall of 1904. It is fairly well defined between gage heights 1.40 and 1.90 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Spanish Fork near Spanish Fork, Utah, for 1904.

[Drainage area, 670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.			Rainfall in inches.[a]
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.	Per cent of rainfall.	
January	113	58	77.6	4,771	0.116	0.134	8.1	1.66
February	126	58	79.1	4,550	.118	.127	7.4	1.71
March	240	63	85.8	5,276	.128	.148	4.4	3.36
April	229	110	174	10,350	.260	.290	28	1.02
May	415	236	343	21,090	.512	.590	25	2.33
June	255	111	162	9,640	.242	.270	41	.66
July	121	80	94.6	5,817	.141	.163	39	.42
August	92	67	75.8	4,661	.113	.130	19	.69
September	75	65	68.0	4,046	.101	.113	13	.85
October	69	65	67.8	4,169	.101	.116	11	1.01
November	72	49	61.5	3,660	.092	.103	.....	.00
December	77	40	54.3	3,339	.081	.093	8.7	1.07
The year	415	40	112	81,370	.167	2.28	15.4	14.78

[a] Mean at Provo, Thistle and Soldiers Summit.

SPANISH FORK NEAR LAKE SHORE, UTAH.

This station was established December 10, 1903, by Caleb Tanner. It is located at the bridge on the highway between Spanish Fork and Lake Shore, about 3 miles west of Spanish Fork. A plain staff gage, graduated to feet and tenths, is driven into the bed of the stream near the west side and about 10 feet below the bridge. It is read twice each day by Frank Simmons. Discharge measurements are made by car and cable about 800 feet above the gage. On May 26, 1904, a gage was established at the cable. The gage heights for the entire year are referred to the original gage. The initial point for soundings is a 2 by 4 inch post driven into the right or south bank, marked "U. S. G. S. Initial point." The course of the section is north 6° west. At 35 feet a 2 by 4 inch post is driven into the north bank and marked "35 feet." The channel is straight for 100 feet above and 50 feet below the station. The current is swift. Both banks are high, composed of earth, and are not subject to overflow. At the left bank there is a lower bank of narrow width, which probably overflows during very high water. The bed of the stream is composed of clean gravel and sand, and is shifting. There is but one channel at all stages. An alternate measuring section was laid off nearly 350 feet upstream, where the bottom is much firmer, which may be used if the first section proves to be too unstable. Bench mark No. 1 bears south 18° 30′ west, 10.5 feet from the gage, being a 30-penny nail driven into a log of the west abutment of the bridge near its northwest corner. Its elevation, 11.68 feet above the zero of the gage, is written in pencil. Bench mark No. 2 bears south 85° 30′ east 91 feet from the gage, being a 20-penny nail driven into the north side of a cedar fence post. Its elevation is 21.95 feet above the zero of the gage. Bench mark No. 3 bears south 21° 45′ east, 197 feet from the gage. It is a United States Geological Survey standard iron pipe bench mark, projecting about 15 inches above the ground. Its elevation above the zero of the gage, 21.76 feet, is stamped on the cap. A nail driven into the top of the initial point post of cross section No. 1 is 8.96 feet above the zero of the gage. The top of the initial post for the alternate cross section is 10.96 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Spanish Fork near Lake Shore, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 3	C. Tanner	25	2.39	3.02	60
February 24	do	44	2.56	3.65	112
March 27	W. P. Hardesty	33	2.69	3.35	88
April 22	C. Tanner	61	2.79	4.22	170
May 20	W. Swendsen	63	2.75	4.08	172
May 20	C. Tanner	65	2.73	4.08	177
May 26	W. Swendsen	33	2.51	3.40	82
December 22	do	22	2.27	[a] 4.61 2.80	50

[a] Gage at cable.

Mean daily gage height, in feet, of Spanish Fork near Lake Shore, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Dec.[a]
1	2.87	(b)	3.27	3.75	4.35	.....
2	2.90	3.00	3.36	3.72	4.37	.....
3	2.90	3.02	3.30	3.72	4.42	.....
4	2.92	2.97	3.35	4.00	4.85	.....
5	2.92	2.97	3.28	4.05	4.75	.....
6	2.92	2.90	3.28	3.90	4.72	.....
7	2.90	2.90	3.27	3.65	5.15	2.80
8	2.87	2.93	3.36	3.62	5.12	2.80
9	2.87	2.90	3.52	3.63	4.97	2.80
10	(b)	2.90	3.25	3.82	5.10	2.80
11	(b)	2.97	3.37	3.90	5.35	2.80
12	(b)	2.92	3.30	4.02	5.35	2.80
13	(b)	2.98	3.32	4.05	5.35	2.80
14	(b)	2.97	3.28	4.17	5.10	2.80
15	(b)	3.02	3.30	4.25	4.75	2.80
16	(b)	3.11	3.32	4.20	4.55	2.80
17	(b)	3.02	3.25	4.10	4.27	2.80
18	(b)	3.90	3.17	4.21	4.27	2.80
19	(b)	3.90	3.10	4.32	4.35	2.80
20	(b)	3.02	3.30	4.50	4.12	2.80
21	(b)	3.06	3.10	4.45	4.27	2.80
22	(b)	3.24	3.00	4.20	4.10	2.80
23	(b)	3.66	3.20	4.15	3.85	2.80
24	(b)	3.71	3.27	4.02	3.80	2.80
25	(b)	3.72	3.30	3.97	3.80	2.80
26	(b)	3.75	3.17	4.15	3.40	2.80
27	(b)	3.52	3.32	4.42	3.42	2.80
28	(b)	3.55	3.30	4.45	3.15	2.80
29	(b)	3.32	5.02	4.45	2.80	2.80
30	(b)	.....	4.17	4.32	2.55	2.80
31	(b)	.....	3.92	.....	2.37	2.80

[a] Gage heights are worked up by a comparison of gage heights at old and new gages and refer to old gage.
[b] Ice.

NOTE.—Total flow of river diverted for irrigation June 1 to December 6.

Rating table for Spanish Fork near Lake Shore, Utah, from January 1 to May 31, 190-.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	42	3.20	71	4.00	158	4.80	262
2.50	43	3.30	78	4.10	171	4.90	275
2.60	45	3.40	87	4.20	184	5.00	288
2.70	47	3.50	96	4.30	197	5.10	301
2.80	50	3.60	107	4.40	210	5.20	314
2.90	54	3.70	119	4.50	223	5.30	327
3.00	58	3.80	132	4.60	236	5.40	340
3.10	64	3.90	145	4.70	249	5.50	353

The above table is applicable only for open-channel conditions. It is based up 8 discharge measurements made during 1904. It is well defined between ga heights 3.00 feet and 4.10 feet. The table has been extended beyond these limi Above gage height 3.70 feet the rating curve is a tangent, the difference being 13 p tenth.

Estimated monthly discharge of Spanish Fork near Lake Shore, Utah, for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January [a]	55	53	53.3	3,2
February	145	53	76.2	4,2
March	291	58	88.7	5,4
April	223	109	168	9,9
May	333	42	202	12,4
June [b]				
December 7–31 [c]				2,4
The period				38,

[a] River frozen January 10 to February 1; discharge estimated.
[b] Stream dry June 1 to December 6.
[c] Water turned in river December 7; average discharge estimated at 50 second-feet.

GREAT SALT LAKE AT SALTAIR, UTAH.

A gage was established March 7, 1904, on Great Salt Lake, Utah. connection with evaporation investigations being carried on at this pla The gage is located 500 feet northwest of the extreme northwest en the temporary extension of the north wing of the bath houses of Saltair pavilion. The gage is a staff, graduated to feet and ten from −4 feet to +4.5 feet, attached to railroad irons driven vertica into the bed of the lake and securely braced. The lower end

driven 1 foot into the lake bed, so that the −4 foot mark is about even with the sand. The zero of this gage is set 6 feet below the zero of the old Lake Shore gage (see Gilbert's Monograph on Lake Bonneville, pp. 231 and 409), and 2.33 feet below the zero of the temporary gage established at Saltair during 1903, by Dr. H. J. Hyatt, director of the United States Weather Bureau at Salt Lake City. Bench mark No. 1 is a United States Geological Survey standard bench-mark cap cemented on the top of the cap of a pile bent of the trestle support of the Salt Lake and Los Angeles Railroad. This is the thirteenth pile bent, 204 feet southeast of the end of the track. Its elevation is 11.17 feet above the zero of the gage, and 4,224.06 feet above sea level, as determined from Salt Lake City datum. Bench mark No. 2 is the head of a large screw driven into the northeast supporting post at the extreme northwest end of the row of bath houses, 500 feet southeast of the gage. Its elevation is 1.56 feet above the zero of the gage, and 4,214.45 feet sea level.

This station was turned over to the United States Weather Bureau.

Mean daily gage height, in feet, of Great Salt Lake at Saltair, Utah, for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1						17					1.20
2		0.8				18				1.50	1.20
3		.8				19	0.3				1.20
4		.8	1.30			20			1.40		1.20
5		.8	1.30	1.40		21			1.40		1.10
6					1.35	22		1.00	1.40		
7						23			1.40		
8		.8	1.30	1.50	1.35	24		1.00			
9		.8		1.50	1.35	25		1.25			
10				1.50		26				1.45	
11				1.50		27				1.40	
12	−0.2			1.50		28	.5		1.35	1.40	
13	.2	.8	1.35	1.50		29	.5		1.40		
14		.8	1.35	1.50		30		1.25			
15			1.35	1.50		31			1.40		
16	.3		1.35	1.50							

SEVIER RIVER NEAR GUNNISON, UTAH.

This station, established by Caleb Tanner on June 29, 1900, is at the wagon bridge which crosses the stream 4 miles west of the town of Gunnison on the road to West View precinct. The gage is a vertical 1 by 4 inch redwood timber painted white and nailed to a bridge pile near right bank of the stream. It is graduated by means of black paint to feet, tenths, and fiftieths. The gage is read once each day by I. H. Erickson. Discharge measurements are made at ordinary stages from the bridge to which the gage is attached. At low water they are made by wading about 200 feet below the bridge. The initial

point for soundings when measurements are made from the bridge is the bridge pile to which the gage is fastened, on the right bank of the stream. When measurements are made by wading the initial point for soundings is a 2 by 4 inch post driven into the right bank of the stream. On the left bank directly opposite the initial point is a 2 by 4 inch post, 93 feet from the initial point. The channel is straight for 300 feet above and below the station. Both banks are about 1 feet above the bed of the stream, covered with salt grass, and are not liable to overflow. The bed of the stream is composed of sand and gravel, free from vegetation, and is permanent. There is one channel at all stages. At low water the low velocity at the bridge makes the measurement inaccurate because of the bridge piles and floating débris. This is overcome by using the section below. Bench mark No. 1 is a large spike driven into the side of a cedar fence post S. 74° E. 46 feet from the gage. Its elevation is 8.55 feet above the zero of the gage. Bench mark No. 2 is a nail in top of railing post at the northeast corner of the bridge, 13 feet north of the gage. Its elevation is 13.18 feet above the zero of the gage. Bench mark No. 3 is S. 84° 30′ E. 153 feet from the gage, and is a United States Geological Survey standard iron bench mark. Its elevation is 10.10 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of Sevier River near Gunnison, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
January 13	C. Tanner	94	2.45	1.99	[illegible]
February 16	do	13	2.55	2.22	[illegible]
February 16	do	13	2.39	2.22	[illegible]
February 16	do	13	2.42	2.22	[illegible]
March 15	do	22	.97	.50	[illegible]
March 30	W. P. Hardesty	19	.74	.38	[illegible]
April 19	E. C. Murphy and C. Tanner.	24	1.04	.52	[illegible]
June 13	W. Swendsen	66	1.14	1.00	[illegible]
August 29	C. Tanner	31	1.26	.72	[illegible]
October 26	do	29	1.10	.68	[illegible]
December 4	W. Swendsen	68	1.17	1.00	[illegible]

Mean daily gage height, in feet, of Sevier River near Gunnison, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	2.40	1.00	0.44	0.48	0.78	0.64	0.56	0.68	0.56	0.68	0.96
2	.....	2.32	.94	.44	.....	.74	.66	.56	.68	.....	.68	.94
3	.....	2.34	.94	.50	.....	.70	.60	.56	.68	.....	.....	1.02
4	2.00	2.30	.84	.50	1.18	.70	.54	.56	.68	.56	.....	1.02
5	2.00	2.44	.82	.50	1.10	.....	.54	.56	.68	.48	.76	1.02
6	2.00	2.30	.82	.60	1.02	1.00	.56	.56	.68	.48	.76	1.02
7	1.90	2.00	.50	.60	.90	1.14	.74	.56	.64	.46	.78	1.00
8	1.76	2.30	.50	.54	.94	1.20	.76	.56	.64	.48	.78	1.00
9	(a)	2.30	.48	.54	1.12	1.10	.54	.56	.60	.48	.80	1.06
10	.....	2.38	.48	.....	1.04	1.08	.54	.56	.60	.46	.80	[b]1.06
11	.....	2.10	.48	.....	1.24	1.20	.54	.56	.58	.48	.....	1.06
12	1.60	1.94	.46	.52	1.20	1.06	.....	.58	.58	.....	.....	1.06
13	2.02	2.24	.48	.54	1.26	.....	.56	.58	.58	.46	.76	1.06
14	2.00	2.00	.48	.56	1.24	1.00	.56	.58	.58	.48	.78	1.06
15	1.66	1.96	.48	.56	1.30	.90	.56	.58	.58	.48	.78	1.06
16	1.60	2.24	.50	.58	1.28	.84	.54	.58	.58	.48	.80	1.06
17	(a)	2.26	.48	.54	1.30	.84	.54	.58	.58	.48	.80	1.06
18	.....	2.22	.48	.52	1.34	.84	.50	.58	.58	.48	.....	1.06
19	.....	2.12	.48	.50	1.44	.80	.50	.80	.58	.48	.....	1.06
20	.....	2.00	.48	.52	1.28	.80	.50	.70	.58	.48	.....	1.06
21	.....	1.76	.48	.52	1.34	.72	.50	.70	.56	.60	.....	1.06
22	.....	1.70	.48	.52	.98	.72	.50	.66	.....	.60	.88	1.06
23	.....	2.00	.46	.50	.88	.70	.50	.68	.56	.60	.86	1 06
24	2.40	1.74	.48	.50	.94	.70	.46	.68	.56	.60	.86	1.06
25	2.32	1.50	.48	.40	.98	.72	.46	.68	.56	.60	.86	1.06
26	2.36	1.40	.48	.46	1.00	.74	.46	.68	.58	.68	.88	1.06
27	2.30	1.20	.28	.46	1.02	.74	.46	.68	.58	.....	.88	1.06
28	2.44	1.14	.28	.46	.90	.70	.50	.70	.58	.68	.94	1.06
29	2.30	1.00	.30	.46	.92	.72	.52	.74	.58	.68	.....	1.06
30	2.30	.....	.30	.48	.88	.....	.56	.74	.56	.....	.96	1.06
31	2.32	.....	.42	.....	.88	.....	.56	.74	.....	.....	.....	1.06

[a] Ice.
[b] December 9 reading assumed for rest of month on account of ice gorge. Highest reading of gorge 4.0 feet.

Rating table for Sevier River near Gunnison, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	8	0.80	49	1.40	152	2.00	269
.30	11	.90	62	1.50	172	2.10	289
.40	16	1.00	77	1.60	191	2.20	308
.50	22	1.10	94	1.70	211	2.30	328
.60	29	1.20	113	1.80	230	2.40	347
.70	38	1.30	133	1.90	250	2.50	367

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is well defined between gage heights 0.40 foot and 2.20 feet. The table has been extended beyond these limits. Above gage height 1.10 feet the rating curve is a tangent, the difference being 19.5 per tenth.

Estimated monthly discharge of Sevier River near Gunnison, Utah, for 1904.

[Drainage area, 3,986 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	355	191	255	15,680	0.064	0.074
February	355	77	267	15,360	.067	.072
March	77	10	27.4	1,685	.0069	.008
April	29	16	22.9	1,363	.0057	.006
May	160	21	92.9	5,712	.023	.027
June	113	36	59.0	3,511	.015	.017
July	45	20	25.7	1,580	.0064	.007
August	59	26	32.8	2,017	.0082	.009
September	36	26	29.6	1,761	.0074	.008
October	36	20	25.7	1,580	.0064	.007
November	71	36	51.4	3,058	.013	.014
December[a]	.....	.....	84.3	5,183	.021	.024
The year	.....	.....	81.1	58,490	.020	.275

[a] Ice gorge December 10–31; discharge estimated.

NOTE.—Discharge estimated for missing gage heights.

SAN PITCH RIVER NEAR GUNNISON, UTAH.

This station was established June 30, 1900, by Caleb Tanner. It is located 4 miles northeast of Gunnison and one-eighth mile west of the Rio Grande and Western Railroad. The station is just west of the second farmhouse along the railroad track north from Gunnison. The gage consists of a vertical timber driven firmly into the bed of the stream and strongly braced, near the left bank of the stream, about 100 feet above the ford. It is painted white and graduated to feet, tenths, and fiftieths. The gage is read once each day by Oliver Pederson. Discharge measurements are made by wading directly under a wire stretched across the river at the station. The initial point for soundings is the west side of a post about 3 feet high, on the left bank, to which the tagged line is attached. The channel is straight for 100 feet above and slightly curved below the station. The current is swift. Both banks are about 5 feet above the bed of the stream, composed of clay, and covered with grass. The bed of the stream is composed of sand and gravel. It is clean and fairly permanent. There is but one channel at all stages. The bed shifts somewhat during floods, but other than this, the conditions are good for accuracy. Bench mark No. 1 is the top of a cedar post, 1 foot in diameter, set firmly in the ground 45.5 feet west of the gage rod. Its elevation is 5.96 feet above the gage datum. Bench mark No. 2 is the top of a nail driven into the top of a stake driven into the ground at the foot of a fence post on the west side of a stockyard S. 84° E. 150 feet from the initial point for soundings. Its elevation is 10.36 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. L. Swendsen, district engineer.

Discharge measurements of San Pitch River near Gunnison, Utah, in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
February 15	C. Tanner	21	0.83	1.82	18
March 16	do	19	.64	1.75	12
March 31	W. P. Hardesty	18	.54	1.68	10
April 19	E. C. Murphy and C. Tanner.	27	2.22	2.13	60
June 14	W. Swendsen	41	[a] 1.79	2.25	75
June 14	do	41	[b] 1.79	2.25	73
June 14	do	41	[c] 1.70	2.25	70
September 1	C. Tanner	22	.94	1.87	21
December 5	W. Swendsen	17	.42	1.62	7

[a] Six-tenth method. [b] Integration method. [c] Top and bottom method.

Mean daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.78	1.80	1.74	1.70	2.26	2.42	2.32	2.34	1.88	1.84	1.86	1.7
2	1.76	1.80	1.72	1.68	2.24	2.40	2.32	2.34	1.86	1.84	1.86	1.7
3	1.78	1.80	1.70	1.68	2.32	2.34	2.32	2.30	1.86	1.84	1.84	1.7
4	1.78	1.80	1.70	1.68	2.30	2.32	2.30	2.30	1.86	1.82	1.86	1.7
5	1.80	1.80	1.70	1.68	2.36	2.30	2.38	2.30	1.84	1.82	1.84	1.7
6	1.80	1.78	1.72	1.68	2.30	2.28	2.46	2.30	1.84	1.80	1.82	1.6
7	1.78	1.78	1.72	1.62	2.38	2.26	2.46	2.30	1.84	1.82	1.82	1.6
8	1.78	1.80	1.72	1.62	2.30	2.32	2.44	2.28	1.84	1.82	1.82	1.7
9	1.70	1.78	1.70	1.64	2.24	2.32	2.46	2.26	1.84	1.84	1.82	1.7
10	1.78	1.76	1.70	1.64	2.24	2.30	2.44	2.24	1.82	1.82	1.92	1.8
11	1.78	1.78	1.70	1.64	2.40	2.24	2.44	2.24	1.82	1.80	1.79	1.7
12	1.80	1.78	1.70	1.68	2.70	2.28	2.44	2.22	1.82	1.82	1.79	1.7
13	1.78	1.78	1.70	1.80	2.56	2.26	2.44	2.20	1.82	1.84	1.80	1.7
14	1.80	1.78	1.70	1.82	2.96	2.26	2.46	2.14	1.82	1.82	1.83	1.7
15	1.78	1.82	1.74	1.88	2.52	2.26	2.48	2.14	1.82	1.84	1.78	1.6
16	1.70	1.78	1.74	1.88	2.96	2.26	2.46	2.13	1.82	1.84	1.78	1.6
17	1.78	1.78	1.74	1.90	2.82	2.26	2.44	1.90	1.82	1.84	1.78	1.7
18	1.78	1.80	1.74	1.90	3.10	2.26	2.42	1.90	1.82	1.84	1.80	1.7
19	1.78	1.82	1.74	2.14	2.74	2.24	2.40	1.88	1.80	1.84	1.80	1.8
20	1.78	1.72	1.70	2.18	2.58	2.20	2.42	1.88	1.80	1.84	1.74	1.7
21	1.80	1.78	1.74	2.14	2.42	2.20	2.42	1.88	1.80	1.84	1.73	1.7
22	1.78	1.80	1.68	2.10	2.44	2.26	2.42	1.86	1.80	1.86	1.72	1.7
23	1.72	1.80	1.70	2.10	2.82	2.26	2.40	1.84	1.80	1.86	1.73	1.7
24	1.78	1.80	1.70	2.10	3.10	2.26	2.40	1.84	1.80	1.86	1.60	1.7
25	1.80	1.78	1.70	2.16	2.90	2.24	2.40	1.84	1.80	1.86	1.69	1.8
26	1.80	1.76	1.70	2.16	2.90	2.24	2.40	1.88	1.82	1.86	1.60	1.8
27	1.80	1.76	1.70	2.24	2.68	2.28	2.34	1.86	1.82	1.86	1.60	1.8
28	1.76	1.76	1.70	2.24	2.64	2.26	2.34	1.86	1.84	1.86	1.64	1.8
29	1.80	1.76	1.80	2.24	2.58	2.30	2.40	1.86	1.84	1.86	1.64	1.8
30	1.78	.....	1.70	2.22	2.54	2.32	2.36	1.88	1.86	1.86	1.64	1.7
31	1.80	.....	1.68	.....	2.36	.....	2.86	1.88	.....	1.86	.....	1.7

Rating table for San Pitch River near Gunnison, Utah, from January 1 to December 31, 1904.

Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	6	2.00	33	2.40	110	2.80	198
1.70	10	2.10	47	2.50	132	2.90	220
1.80	16	2.20	66	2.60	154	3.00	242
1.90	23	2.30	88	2.70	176		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904. It is well defined between gage heights 1.60 feet and 2.30 feet. The table has been extended beyond these limits. At gage height 2.20 feet the rating curve is a tangent, the difference being 22 per cent.

Estimated monthly discharge of San Pitch River near Gunnison, Utah, for 1904.

[Drainage area, 836 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	16	10	14.8	910	0.018	0.021
February	17	14	15.2	874	.018	.019
March	12	9	10.7	658	.013	.015
April	75	7	31.6	1,880	.038	.042
May	264	75	147	9,039	.176	.203
June	114	66	83.5	4,969	.100	.112
July	128	88	111	6,825	.133	.153
August	97	19	50.4	3,099	.060	.069
September	22	16	17.8	1,059	.021	.023
October	20	16	18.7	1,150	.022	.025
November	24	6	14.2	845	.017	.019
December	16	6	9.9	609	.012	.014
The year	264	6	43.7	31,920	.052	.715

HUMBOLDT RIVER (NORTH FORK) NEAR ELBURZ, NEV.

This station was established October 10, 1902, by E. C. Murphy. It is located 150 feet below the Southern Pacific Railroad bridge and about one-fourth mile above the junction of the North Fork with Humboldt River. It is 2 miles west of the Southern Pacific Railroad station at Elburz. The nearest post-office is Halleck, Nev. The gage is an inclined 4 by 4 inch timber fastened to the left bank just above the cable. It is read once each day by A. R. Blevins. Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero on the tagged wire. The channel is straight for 150 feet above and below the station. There is but one channel at all stages, and the current is sluggish. Both banks are high. The left bank will overflow at extreme flood stages. The bed of the stream is composed of gravel and silt, and changes slightly. The bench mark is a 4 by 4 inch timber driven in the ground on the left bank about 20 feet upstream from the gage. Its elevation is 6.99 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Humboldt River (North Fork) near Elburz, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	W. A. Wolf	40	87	2.28	4.15	198
April 11	do	40	89	2.11	4.10	188
May 3	do	40	95	1.90	4.06	180
May 17	do	40	88	1.84	4.00	162
June 7 [a]	do	40	104	1.54	4.75	160
June 17	do	41	82	1.18	4.65	97
June 28	do	38	23	1.52	3.55	35
July 9	do	38	20	1.28	3.40	26
July 18	do	15	17	1.39	3.35	24
August 18	do	9	6.5	1.04	3.10	6.8

[a] Backwater.

Mean daily gage height, in feet, of Humboldt River (North Fork) near Elburz, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.00	4.10	4.60	4.00	5.20	3.50	3.20	3.00	3.10	3.30	3.50
2	1.90	2.00	4.30	4.50	4.10	5.10	3.40	3.15	3.00	3.10	3.30	3.50
3	1.90	2.00	4.40	4.40	4.10	.....	3.40	3.15	3.00	3.10	3.30	3.50
4	1.90	2.00	4.30	4.30	4.00	5.10	3.40	3.15	3.00	3.10	3.30	3.50
5	1.90	2.00	4.20	4.20	3.90	5.00	3.40	3.15	3.00	3.15	3.30	3.50
6	1.90	2.00	4.00	4.20	3.80	.....	3.40	3.10	3.00	3.15	3.30	3.40
7	1.90	2.10	3.80	4.10	3.70	4.80	3.40	3.10	3.00	3.15	3.30	3.40
8	1.90	2.10	3.80	4.10	3.60	4.90	3.40	3.10	3.00	3.15	3.30	3.40
9	1.90	2.10	4.00	4.10	3.50	5.00	3.40	3.10	3.00	3.15	3.30	3.30
10	1.90	2.10	4.10	4.00	3.60	4.90	3.40	3.10	3.00	3.20	3.30	3.30
11	1.90	2.20	4.10	4.00	3.70	4.80	3.30	3.10	3.00	3.20	3.30	3.30
12	1.90	2.20	4.00	4.10	3.80	4.80	3.30	3.10	3.00	3.20	3.30	3.40
13	1.90	2.30	3.90	4.10	4.00	4.80	3.40	3.10	3.00	3.25	3.30	3.40
14	1.90	2.70	3.90	4.20	4.10	4.70	3.40	3.10	3.00	3.25	3.25	3.40
15	1.90	2.70	4.00	4.30	4.10	4.70	3.40	3.10	3.00	3.30	3.25	3.40
16	1.90	2.70	4.00	4.40	4.00	4.60	3.35	3.10	3.00	3.30	3.20	3.30
17	1.80	2.30	3.90	4.40	4.10	4.50	3.35	3.10	3.00	3.30	3.20	3.30
18	1.80	2.40	4.00	4.50	4.10	4.40	3.35	3.10	3.00	3.30	3.20	3.30
19	1.80	2.40	4.00	4.50	4.20	4.40	3.35	3.10	3.00	3.30	3.20	3.30
20	1.80	2.40	4.00	4.40	4.30	4.30	3.35	3.10	3.00	3.30	3.20	3.30
21	1.80	2.80	4.00	4.30	4.40	4.10	3.35	3.05	3.00	3.30	3.20	3.35
22	1.80	2.70	4.10	4.20	5.40	4.00	3.35	3.05	3.00	3.30	3.20	3.40
23	1.80	2.80	4.00	4.10	5.10	3.90	3.30	3.00	3.00	3.30	3.20	3.40
24	1.90	.....	4.10	4.40	5.00	3.80	3.30	3.00	3.00	3.30	3.15	3.40
25	1.90	6.00	4.20	4.30	4.90	3.70	3.30	3.00	3.05	3.30	3.10	3.45
26	1.90	5.40	4.10	4.20	5.50	3.50	3.30	3.00	3.10	3.30	3.10	3.45
27	1.90	5.00	4.00	4.20	5.60	3.40	3.30	3.00	3.10	3.30	3.20	3.50
28	1.90	4.20	4.00	4.10	5.60	3.40	3.20	3.00	3.10	3.30	3.20	3.55
29	2.00	4.00	4.10	4.00	5.50	3.40	3.20	3.00	3.10	3.30	3.20	3.60
30	2.00	.....	4.20	3.90	.....	3.50	3.20	3.00	3.10	3.30	3.15	3.60
31	2.00	.....	4.40	.....	5.30	.....	3.20	3.00	.....	3.30	.....	3.60

NOTE.—River frozen January 1 to February 23 (practically no flow).

Rating table for Humboldt River (North Fork) near Elburz, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	5	3.80	105	4.60	328	5.40	552
3.10	7	3.90	132	4.70	356	5.50	580
3.20	11	4.00	160	4.80	384	5.60	608
3.30	18	4.10	188	4.90	412	5.70	636
3.40	27	4.20	216	5.00	440	5.80	664
3.50	40	4.30	244	5.10	468	5.90	692
3.60	59	4.40	272	5.20	496	6.00	720
3.70	81	4.50	300	5.30	524		

NOTE.—From February 24 to 28 and from May 22 to June 22, 1904, take 50 per cent of the discharge given in the table, on account of backwater.

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 3.10 feet and 4.15 feet. The table has been extended beyond these limits. Above gage height 3.85 feet the rating curve is a tangent, the difference being 28 per tenth.

Estimated monthly discharge of Humboldt River (North Fork) near Elburz, Nev., for 1904.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
February 25–29	720	160	418	4,046	0.410	0.076
March	412	105	184	11,310	.180	.208
April	328	132	226	13,450	.222	.248
May	608	40	274	16,850	.269	.310
June	496	27	284	16,900	.278	.310
July	40	11	22.2	1,365	.022	.025
August	11	5	6.7	412	.0066	.0076
September	7	5	5.4	321	.0053	.0059
October	18	7	14.0	861	.014	.016
November	18	7	13.8	821	.014	.016
December	59	11	26.8	1,648	.026	.030
The period				67,980		

HUMBOLDT RIVER AT PALISADE, NEV.

This station was established November 27, 1902, by E. C. Murphy. The gage is a vertical 1 by 4 inch board spiked to the right abutment of the single-span highway bridge one-fourth mile from the hotel at Palisade. It is read once each day by T. H. Jewell, the hotel keeper. There is a railroad bridge about 500 feet below. Discharge measurements are made by means of a cable and car one-fourth mile above the gage. At very low stages, when the current becomes sluggish at the cable, measurements are made by wading a short distance above. The initial point for soundings is the zero on the tagged wire. The channel is straight for 200 feet above and for 300 feet below the station. The right bank is low and liable to overflow. The left bank is high. The bed of the stream is composed of gravel and sand and is permanent. There is but one channel at all stages. The bench mark consists of a spike and three nails driven into the bridge abutment to which the gage is fastened. Its elevation is 7.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Humboldt River at Palisade, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 23	W. A. Wolf	104	350	2.13	3.81	745
April 13	do	105	410	2.35	4.30	96[illegible]
May 4	do	103	460	2.53	4.65	1,16[illegible]
May 16	do	106	460	2.50	4.62	1,15[illegible]
June 6	do	110	578	2.92	5.80	1,68[illegible]
June 16	do	110	556	2.90	5.60	1,61[illegible]
June 27	do	106	466	2.45	4.58	1,14[illegible]
July 8	do	104	313	1.91	3.45	59[illegible]
July 18	do	103	282	1.88	3.10	53[illegible]
July 27	do	97	209	1.43	2.40	2[illegible]
August 17	do	40	43	1.75	1.40	[illegible]
September 5	do	30	36	1.56	1.30	[illegible]

Mean daily gage height, in feet, of Humboldt River at Palisade, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.60	1.50	4.90	4.30	4.70	6.00	4.10	1.95	1.30	1.40	1.90	1.95
2	1.60	1.50	5.40	4.30	4.70	6.00	3.95	1.90	1.30	1.50	1.90	1.95
3	1.60	1.50	4.90	4.50	4.70	6.00	3.70	1.90	1.30	1.60	1.90	1.95
4	1.60	1.50	4.50	4.60	4.70	5.90	3.60	1.80	1.30	1.60	1.90	1.95
5	1.60	1.50	4.20	4.50	4.70	5.90	3.55	1.70	1.30	1.60	1.90	1.95
6	1.60	1.50	4.60	4.40	5.00	5.90	3.50	1.70	1.40	1.60	1.90	1.95
7	1.50	1.50	4.60	4.40	4.70	5.80	3.45	1.70	1.40	1.60	1.90	1.95
8	1.50	1.50	4.70	4.40	4.70	5.80	3.45	1.65	1.40	1.60	1.90	1.95
9	1.50	1.55	4.50	4.20	4.60	5.80	3.45	1.60	1.40	1.60	1.90	1.95
10	1.50	1.60	3.80	4.20	4.50	5.70	3.45	1.60	1.40	1.60	1.90	1.95
11	1.50	1.65	3.80	4.20	4.50	5.70	3.40	1.60	1.40	1.75	1.90	1.95
12	1.55	1.65	3.70	4.40	4.40	5.70	3.35	1.55	1.40	1.75	1.90	1.95
13	1.55	1.70	3.90	4.50	4.50	5.60	3.30	1.50	1.40	1.80	1.95	1.90
14	1.60	1.70	3.90	4.40	4.50	5.50	3.20	1.40	1.40	1.80	1.95	1.80
15	1.60	1.70	3.90	4.50	4.50	5.50	3.20	1.40	1.40	1.80	1.95	1.75
16	1.60	2.00	3.70	4.60	4.60	5.50	3.20	1.40	1.40	1.90	1.95	1.75
17	1.60	3.00	3.70	4.70	4.60	5.40	3.15	1.40	1.40	1.90	1.95	1.75
18	1.60	1.50	3.80	4.70	4.70	5.40	3.10	1.40	1.40	1.90	1.95	1.70
19	1.60	2.00	3.90	4.70	4.70	5.40	3.00	1.40	1.40	1.90	1.95	1.70
20	1.50	2.00	3.90	4.90	4.90	5.20	3.00	1.40	1.30	1.90	1.95	1.70
21	1.50	2.20	3.80	5.00	5.00	5.20	2.90	1.40	1.30	1.90	1.95	1.70
22	1.50	5.00	3.80	5.00	5.20	5.20	2.80	1.40	1.30	1.90	1.95	1.70
23	1.50	6.00	3.80	4.90	5.30	5.10	2.70	1.40	1.30	1.90	1.95	1.70
24	1.50	4.50	3.80	4.90	5.40	5.00	2.60	1.40	1.30	1.90	1.95	1.70
25	1.50	4.60	3.80	4.90	5.80	4.90	2.60	1.40	1.40	1.90	1.95	1.70
26	1.50	4.90	3.80	4.90	6.00	4.80	2.50	1.40	1.40	1.90	1.95	1.70
27	1.50	4.95	3.80	4.90	6.00	4.60	2.40	1.40	1.40	1.90	1.95	1.70
28	1.50	5.20	3.80	4.70	6.00	4.50	2.35	1.40	1.40	1.90	1.95	1.70
29	1.50	4.70	3.80	4.50	6.00	4.40	2.20	1.40	1.40	1.90	1.95	1.75
30	1.50	.....	4.50	4.60	6.00	4.30	2.00	1.40	1.40	1.90	1.95	1.80
31	1.50	.....	4.30	.....	6.00	.....	2.00	1.40	.....	1.90	.....	1.80

Rating table for Humboldt River at Palisade, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	57	2.40	279	3.50	643	4.60	1,135
1.40	70	2.50	307	3.60	682	4.70	1,185
1.50	85	2.60	336	3.70	722	4.80	1,235
1.60	101	2.70	366	3.80	764	4.90	1,285
1.70	119	2.80	397	3.90	806	5.00	1,335
1.80	139	2.90	429	4.00	850	5.10	1,385
1.90	159	3.00	462	4.10	895	5.20	1,435
2.00	180	3.10	496	4.20	941	5.40	1,535
2.10	202	3.20	531	4.30	988	5.60	1,635
2.20	226	3.30	567	4.40	1,036	5.80	1,735
2.30	252	3.40	605	4.50	1,085	6.00	1,835

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.30 feet and 5.80 feet. Above gage height 4.50 feet the rating curve is a tangent, the difference being 50 per tenth.

Estimated monthly discharge of Humboldt River at Palisade, Nev., for 1904.

[Drainage area, 5,014 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	101	85	91.7	5,638	0.018	[illegible]
February	1,835	85	461	26,520	.092	[illegible]
March	1,535	722	910	55,950	.181	[illegible]
April	1,335	941	1,128	67,120	.225	[illegible]
May	1,835	1,036	1,345	82,700	.268	[illegible]
June	1,835	988	1,532	91,160	.306	[illegible]
July	895	180	500	30,740	.100	[illegible]
August	169	70	91.4	5,620	.018	[illegible]
September	70	57	65.7	3,909	.013	[illegible]
October	159	70	135	8,301	.027	[illegible]
November	169	159	165	9,818	.033	[illegible]
December	169	119	143	8,793	.029	[illegible]
The year	1,835	57	547	396,300	.109	[illegible]

HUMBOLDT RIVER NEAR GOLCONDA, NEV.

The gaging station at Golconda is located near the great northern bend of Humboldt River and below the central valley. It is about [illegible] miles above the mouth of Little Humboldt River. The station was established by L. H. Taylor October 24, 1894, and has been maintained continuously since that time. It is located 1¼ miles north of the town. An inclined gage, installed November 28, 1902, by E. C. Murphy, was fastened to the left bank by 4 by 4 inch stakes. The zeros of this and the original gage were at the same elevation. The bench mark was a 4 by 4 inch timber driven 4 feet north of the cable post on the left bank, at an elevation of 10.75 feet above the zero of the gage. Measurements prior to 1904 were made from a cable and car. During 1904 the discharge measurements were made from the upper side of a wagon bridge, constructed during the winter of 1903–4, [illegible] feet above the cable. A new gage rod and bench mark were established October 4, 1904. The new gage is a 4 by 4 inch timber driven vertically into the river bed, and its upper end is securely fastened to a stringer on the downstream side of the north or right end of the wagon bridge. The new bench mark is the head of the lowest rivet of the strut at the northwest corner of the bridge. The elevation of the new bench mark is 13.42 feet above the zero of the new gage. The

new bench mark is 0.48 foot lower than the old bench mark, so that the new gage zero is 3.15 feet below the old zero. The banks are moderately high, but liable to overflow at extreme high water. The bed of the stream is of gravel and sand and is somewhat shifting.

The channel is straight for 300 feet above and for 100 feet below the station. There is but one channel at all stages. At the cable the current is sluggish at low stages, but measurements can be made above or below by wading. The gage is read once each day by Walter Lyng.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Humboldt River near Golconda, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 24	W. A. Wolf	80	344	1.93	5.43	663
April 14	do	81	429	2.02	6.30	861
May 5	do	81	443	2.06	6.60	913
May 15	do	80	381	1.93	5.72	737
June 5	do	81	412	2.01	6.20	830
June 15	do	83	478	2.20	6.75	1,050
June 26	do	83	444	2.09	6.35	930
July 7	do	82	376	2.00	5.80	752
July 19	do	75	227	1.73	4.10	394
July 28	do	67	185	1.43	3.50	265
August 20	do	43	46	1.59	1.35	70
September 3	do	41	25	1.39	.95	35
October 1	do	24	25	1.30	1.00	34

Mean daily gage height, in feet, of Humboldt River near Golconda, Nev., for 190

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	−0.80	−0.70	4.40	6.00	6.60	a5.80	6.00	a3.25	a1.10	0.80	a1.85	
2	− .80	− .60	4.80	6.00	a6.70	a5.90	6.20	a3.10	1.00	a.80	1.85	
3	− .80	− .40	5.00	6.10	6.80	6.00	a6.20	3.00	.90	a.85	a1.90	
4	− .80	− .20	5.10	6.20	a6.70	6.00	a6.10	3.00	a.80	a.85	1.75	
5	− .70	.00	5.20	6.30	6.60	a6.15	a6.10	2.90	a.70	.85	1.75	
6	− .70	.20	5.20	6.30	a6.50	a6.30	6.00	2.90	a.60	.85	a1.85	
7	− .80	.30	5.30	6.40	6.40	6.50	a6.00	a2.90	.60	.95	a1.95	
8	− .90	.40	5.40	6.50	a6.30	a6.65	6.00	a2.80	.40	1.65	a2.00	
9	− .90	.50	5.30	6.80	a6.25	a6.80	5.80	a2.80	.40	a1.55	2.06	
10	− .90	.50	5.20	a6.80	6.20	6.80	a5.70	2.80	.30	a1.45	2.05	
11	− .90	.60	5.10	a6.80	a6.10	6.80	a5.65	2.70	.30	a1.40	2.15	
12	− .90	.70	5.00	6.80	6.00	a6.80	5.60	2.70	a.30	1.35	2.25	
13	− .90	.70	5.10	a6.55	5.60	a6.80	5.40	2.60	a.30	1.85	2.25	
14	− .90	.80	5.20	6.30	a5.60	a6.70	a5.30	a2.40	a.30	1.85	a2.25	
15	− .90	1.00	5.20	a6.65	a5.60	6.70	5.25	a2.20	.30	1.75	a2.25	
16	− .90	1.00	5.20	7.00	5.60	6.70	5.20	2.00	.20	1.75	2.25	
17	− .90	1.20	5.30	a6.65	a5.50	6.60	5.20	a1.75	.10	a1.65	a2.35	
18	− .90	1.20	5.30	6.30	a5.35	6.60	a5.00	a1.50	.10	a1.60	2.45	
19	− .90	1.30	5.30	a6.15	5.20	a6.50	a4.75	1.30	a.10	1.55	2.45	
20	− .90	1.30	5.30	6.00	5.10	a6.50	a4.50	1.10	a.10	1.55	2.45	
21	− .90	1.50	5.30	a6.00	5.10	6.40	4.30	a1.10	a.10	1.55	a2.45	
22	− .90	1.70	5.30	6.00	a5.00	6.40	3.80	a.90	.10	a1.60	a2.45	
23	− .90	1.80	5.40	6.10	4.90	a6.35	3.80	a.80	.00	1.65	2.45	
24	− .90	2.00	5.40	6.10	a5.15	6.30	a3.75	.80	.00	a1.70	2.45	
25	− .90	2.40	5.50	a6.15	5.40	6.30	3.70	.60	a.20	a1.70	2.55	
26	− .90	2.60	5.50	6.20	a5.40	a6.35	3.70	.70	.40	1.75	a2.45	
27	− .90	3.00	5.60	a6.30	5.40	6.20	3.70	.80	a.55	a1.80	2.35	
28	− .90	3.60	5.70	a6.35	5.20	6.20	a3.60	a1.15	a.70	1.85	a2.35	
29	− .80	3.80	5.80	6.40	5.20	a6.10	a3.60	1.50	.80	1.85	a2.35	
30	− .80	.....	6.00	6.50	5.50	a6.10	3.50	1.30	.80	a1.85	2.35	
31	− .80	.....	6.00	.....	a5.65	.....	a3.40	a1.20	.....	a1.85	.....	

a Interpolated

NOTE.—Gage heights for entire year refer to old gage. River frozen January 1 to February 4.

Rating table for Humboldt River near Golconda, Nev., from February 5 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	4	1.50	75	3.00	221	4.50	450
0.10	6	1.60	83	3.10	233	4.60	470
0.20	8	1.70	91	3.20	245	4.70	490
0.30	10	1.80	99	3.30	258	4.80	511
0.40	13	1.90	108	3.40	271	5.00	554
0.50	16	2.00	117	3.50	285	5.20	599
0.60	20	2.10	126	3.60	299	5.40	646
0.70	24	2.20	136	3.70	314	5.60	694
0.80	29	2.30	146	3.80	329	5.80	743
0.90	35	2.40	156	3.90	344	6.00	793
1.00	41	2.50	166	4.00	360	6.20	845
1.10	47	2.60	177	4.10	377	6.40	898
1.20	54	2.70	188	4.20	394	6.60	952
1.30	61	2.80	199	4.30	412	6.80	1,007
1.40	68	2.90	210	4.40	431	7.00	1,063

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904 and 2 measurements of 1903. It is not very well defined, owing to the shifting character of the bed.

Estimated monthly discharge of Humboldt River near Golconda, Nev., for 1904.

[Drainage area, 10,780 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
February 5–29	329	4	81.6	4,047	0.0076	0.0071
March	793	431	625	38,430	.058	.067
April	1,063	793	887	52,780	.082	.091
May	1,007	532	739	45,440	.069	.080
June	1,007	743	902	53,670	.084	.094
July	845	271	562	34,560	.052	.060
August	252	20	124	7,624	.012	.014
September	47	4	15.8	940	.0015	.0017
October	104	29	76.2	4,685	.0071	.0082
November	172	95	138	8,212	.013	.014
December	252	104	173	10,640	.016	.018
The period				261,000		

NOTE.—From April to December, inclusive, several days in each month are interpolated. River frozen January 1 to February 4, with only a slight flow.

HUMBOLDT RIVER NEAR OREANA, NEV.

On the lower reaches of this river measurements have been mai for a number of years near Oreana, and the results show the amoun of water available for storage at the possible reservoir sites in t vicinity of Humboldt station and also for the six canal systems no in operation below Oreana. The station established by L. H. Tayl January 27, 1896, was located at the old Oreana highway bridge, about 1 miles northeast of Lovelocks, Nev. The bridge abutment to which th gage was fastened was undermined and fell May 26, 1897. A temporar gage was used until September 8, 1897, when a new inclined one wa placed on the left bank of the river about a mile and a half above the sit of the old gage and opposite the Central Pacific Railroad section hous

This gage was washed out. The present gage was establish November 29, 1902, by E. C. Murphy. It is vertical, in two sections, and is spiked to piles at the site of the old dam. The datum is t same as that of the old gage. The gage is read once each day b W. M. Maughmer. Discharge measurements are made at high water b means of a cable and car located at the gage. At low water measu ments are made by wading a short distance below the station. Th channel is straight for 300 feet above and for 200 feet below t station. The current is moderate. The right bank is high and w not overflow. The left bank will overflow only at extreme hig water. There is but one channel at all stages. The bed of the stre is sandy and shifting. The bench mark consists of 4 nails drive into the pile to which the upper section of the gage is fastened. It elevation is 5.00 feet above the zero of the gage. On October 1, 19 the gage rod was lowered 2 feet. The elevation of the bench mar is now 7.00 feet above the zero of the gage.

The observations at this station during 1904 have been made un the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Humboldt River near Oreana, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis
			Square feet.	*Ft. per sec.*	*Feet.*	*Sec*
March 25	W. A. Wolf	109	241	2.07	2.48	
April 9	do	110	292	2.24	3.01	
May 6	do	110	335	2.35	3.46	
May 14	do	110	295	2.25	2.97	
June 4	do	110	273	2.15	2.85	
June 15	do	110	338	2.24	3.41	
June 25	do	106	287	2.29	3.15	
July 6	do	110	337	2.24	3.40	
July 17	do	110	280	2.18	2.90	
August 16	do	101	78	1.60	.88	
September 2	do	77	36	1.19	.40	
September 30	do	22	18	.97	.20	

Mean daily gage height, in feet, of Humboldt River near Oreana, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.10	0.20	0.60	2.80	3.90	2.50	3.42	1.75	0.40	0.20	0.60	0.80
2	.10	.30	.60	2.80	4.00	2.60	3.40	1.70	.40	.20	.60	.80
3	.10	.50	.70	2.90	4.00	2.70	3.40	1.60	.35	.20	.60	.80
4	.20	.60	.80	2.90	3.90	2.90	3.40	1.55	.30	.20	.60	1.00
5	.20	.60	.80	2.90	3.70	2.82	3.40	1.50	.30	.20	.60	1.10
6	.20	.80	1.00	3.00	3.50	2.80	3.38	1.40	.30	.20	.60	1.10
7	.20	.80	1.30	3.00	3.40	2.88	3.35	1.35	.30	.25	.60	1.10
8	.20	.80	1.60	3.10	3.30	2.88	3.32	1.30	.30	.20	.60	1.10
9	.20	.90	1.70	3.10	3.30	2.88	3.30	1.25	.30	.80	.60	1.10
10	.20	1.00	1.90	3.10	3.10	2.85	3.20	1.20	.30	.80	.60	1.10
11	.20	1.00	1.90	3.10	3.10	2.85	3.15	1.15	.30	.60	.60	1.15
12	.20	1.10	1.90	3.20	3.00	2.90	3.10	1.10	.25	1.20	.65	1.20
13	.20	1.30	2.00	3.20	2.80	3.00	3.00	1.05	.25	.90	.65	1.25
14	.20	1.20	2.00	3.20	2.80	3.00	2.90	1.00	.20	.50	.65	1.30
15	.20	1.00	2.10	3.20	2.80	3.10	2.85	.95	.15	.40	.65	1.40
16	.20	.80	2.20	3.20	2.80	3.30	2.80	.90	.10	.40	.70	1.45
17	.20	.60	2.20	3.10	2.70	3.40	2.75	.85	.10	.50	.70	1.50
18	.20	.50	2.20	3.10	2.70	3.55	2.70	.85	.10	.50	.70	1.50
19	.20	.30	2.30	3.10	2.70	3.50	2.65	.80	.05	.50	.70	1.40
20	.20	.20	2.30	3.10	2.70	3.40	2.60	.75	.05	.55	.75	1.20
21	.20	.30	2.40	3.10	2.70	3.30	2.55	.70	.05	.55	.75	1.10
22	.20	.30	2.40	3.00	2.70	3.20	2.50	.65	.10	.60	.75	1.00
23	.20	.20	2.50	3.00	2.68	3.15	2.40	.60	.10	.60	.75	1.00
24	.20	.20	2.50	3.00	2.65	3.05	2.30	.55	.25	.60	.75	.90
25	.20	.20	2.60	2.90	2.65	3.00	2.20	.60	.30	.60	.80	1.00
26	.20	.20	2.60	2.90	2.60	3.10	2.10	.60	.40	.60	.80	1.10
27	.20	.20	2.60	3.10	2.40	3.15	2.05	.60	.30	.60	.80	1.20
28	.20	.30	2.60	3.40	2.10	3.20	2.00	.55	.25	.60	.80	1.30
29	.20	.50	2.60	3.60	2.05	3.30	1.95	.50	.25	.60	.80	1.25
30	.20	.....	2.70	3.80	2.15	3.45	1.90	.45	.25	.60	.80	1.20
31	.20	.....	2.70	.....	2.30	.....	1.80	.45	.....	.60	.....	1.15

NOTE.—Gage heights for entire year refer to old gage.

Rating table for Humboldt River near Oreana, Nev , from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.05	3	1.10	164	2.10	383	3.10	668
0.10	7	1.20	183	2.20	419	3.20	698
0.20	17	1.30	203	2.30	445	3.30	728
0.30	29	1.40	223	2.40	466	3.40	758
0.40	43	1.50	243	2.50	494	3.50	790
0.50	59	1.60	264	2.60	522	3.60	822
0.60	75	1.70	286	2.70	550	3.70	854
0.70	92	1.80	310	2.80	578	3.80	886
0.80	110	1.90	334	2.90	608	3.90	918
0.90	128	2.00	358	3.00	638	4.00	950
1.00	146						

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1904. It is well defined between gage heights 0.15 foot and 3.50 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Humboldt River near Oreana, Nev., for 1904.

[Drainage area, 13,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	17	7	16.0	984	0.0012	0.01
February	203	17	76.6	4,406	.0056	.06
March	550	75	363	22,320	.026	.03
April	886	578	667	39,690	.048	.05
May	950	370	625	38,430	.045	.05
June	806	494	656	39,040	.048	.05
July	764	310	575	35,360	.042	.04
August	298	51	145	8,916	.011	.01
September	43	3	22.2	1,321	.0016	.00
October	183	17	63.0	3,874	.0046	.00
November	110	75	89.7	5,338	.0065	.00
December	243	110	174	10,700	.013	.01
The year	950	3	289	210,400	.021	.28

HUMBOLDT RIVER (SOUTH FORK) NEAR ELKO, NEV.

The station, established August 29, 1896, by L. H. Taylor, is located 10 miles southwest of the town of Elko, at Cislini's (formerly Mason's) ranch, and about 6 miles above the junction of the South Fork with the main stream. The gage is inclined and spiked to posts driven firmly into the right bank. A new inclined gage was installed by E. C. Murphy November 22, 1902. It is at the site of the old one, the 4-foot marks of the old and new gages coinciding. The bench mark is a 4 by 4 inch timber driven 4 feet south of the gage. It is 6.29 feet above gage datum. The measurements are made from a cable and car at a point 1 mile above the gage, the latter being placed near the ranch of the observer, M. Cislini, for his convenience. At the point of measurement the banks are high, and the channel is straight for some distance above and below the station. The bed of the stream is composed of gravel and is stable. There is a good site for a reservoir a short distance above the station.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Humboldt River (South Fork) near Elko, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 22	W. A. Wolf	42	60	1.43	1.00	86
April 12	do	44	78	2.31	1.66	180
May 1	do	45	96	2.18	1.75	210
June 8	do	47	177	4.20	3.80	743
June 17	do	46	162	4.18	3.70	677
June 27	do	46	111	2.88	2.30	320
July 10	do	45	100	2.10	1.90	210
July 18	do	44	92	2.05	1.75	189
August 19	do	19	15	1.28	.50	19
September 15	do	16	13	1.36	.50	17
October 2	do	15	9.2	1.31	.40	12

Mean daily gage height, in feet, of Humboldt River (South Fork) near Elko, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.30	0.00	1.15	1.55	1.75	4.00	2.40	0.75	0.50	0.30	0.75	0.00
2	.30	.00	1.10	1.55	1.95	4.25	2.20	.65	.50	.40	.75	.00
3	.30	.00	1.10	1.40	2.02	4.25	2.20	.55	.50	.45	.75	.00
4	.30	.00	1.10	1.55	2.25	4.25	2.20	.45	.50	.45	.75	.00
5	.30	.00	1.05	1.35	2.25	4.12	2.00	.35	.50	.45	.75	.00
6	.30	.00	1.05	1.40	2.10	4.00	1.85	.30	.50	.45	.00	.00
7	.30	.10	1.05	1.40	2.10	4.00	1.85	.00	.50	.50	.00	.00
8	.30	.10	1.05	1.40	2.02	3.80	1.85	.00	.50	.50	.00	.00
9	.30	.10	1.05	1.40	1.95	4.00	1.75	.00	.50	.50	.00	.00
10	.00	.10	1.05	1.40	2.10	4.00	1.90	.00	.50	.50	.00	.00
11	.00	.10	1.05	1.48	2.25	4.00	1.85	.00	.50	.50	.00	.00
12	.00	.10	1.05	1.70	2.45	4.00	2.00	.00	.50	.50	.00	.00
13	.00	.10	1.05	1.70	2.45	4.00	2.20	.00	.50	.50	.00	.00
14	.00	.15	1.05	1.95	2.60	4.00	2.10	.00	.50	.50	.00	.00
15	.00	.20	1.05	1.95	2.60	3.90	1.70	3.10	.50	.50	.00	.00
16	.00	.25	1.05	2.02	2.70	3.90	1.55	.00	.50	.50	.00	.00
17	.00	.30	1.05	2.10	2.80	3.70	1.40	.40	.50	.50	.00	.00
18	.00	.30	1.05	2.10	3.05	3.80	1.75	.20	.50	.50	.00	.00
19	.00	.25	1.05	2.02	3.35	3.80	1.20	.50	.50	.50	.00	.00
20	.00	.20	1.05	1.95	3.55	3.67	1.10	.50	.50	.50	.00	.00
21	.00	.....	1.05	1.95	3.80	3.55	2.60	.30	.50	.50	.00	.00
22	.00	.....	1.05	1.95	4.00	3.35	2.40	.20	.50	.50	.00	.00
23	.00	.....	1.05	1.95	4.25	2.40	2.00	.20	.50	.60	.00	.00
24	.00	.....	.90	1.95	4.50	2.20	1.85	.20	.50	.60	.00	.00
25	.00	.....	.90	1.80	5.00	1.85	1.70	.20	.50	.75	.00	.00
26	.00	.....	.90	1.88	5.25	1.95	1.55	.20	.50	.75	.00	.00
27	.00	.....	1.00	1.95	4.75	2.20	1.40	.20	.50	.75	.00	.00
28	.00	.....	1.05	1.95	4.75	2.00	1.25	.20	.50	.75	.00	.00
29	.00	.....	1.70	1.80	4.50	2.20	1.10	.20	.50	.75	.00	.00
30	.00	.....	1.55	.....	4.25	2.40	.95	.20	.50	.75	.00	.00
31	.00	.....	1.55	.....	4.00	.....	.85	.20	.....	.75	.....	.00

Rating table for Humboldt River (South Fork) near Elko, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
0.00	2	1.40	133	2.80	444	4.10	815
.10	3	1.50	150	2.90	471	4.20	845
.20	5	1.60	168	3.00	498	4.30	876
.30	8	1.70	187	3.10	526	4.40	907
.40	12	1.80	207	3.20	554	4.50	938
.50	17	1.90	228	3.30	582	4.60	970
.60	24	2.00	249	3.40	610	4.70	1,002
.70	33	2.10	271	3.50	639	4.80	1,034
.80	44	2.20	293	3.60	668	4.90	1,067
.90	57	2.30	316	3.70	697	5.00	1,100
1.00	71	2.40	340	3.80	726	5.10	1,133
1.10	86	2.50	365	3.90	755	5.20	1,166
1.20	101	2.60	391	4.00	785	5.30	1,200
1.30	117	2.70	417				

The above table is applicable only for open-channel conditions. It is based upon 17 discharge measurements made during 1902 to 1904, inclusive, and is well defined.

Estimated monthly discharge of Humboldt River (South Fork) near Elko, Nev., for 1904.

[Drainage area, 1,150 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	8	2	3.7	228	0.0032	0.00
February 1–20	8	2	3.8	151	.0033	.00
March	187	57	85.8	5,276	.075	.08
April	271	125	198	11,780	.172	.19
May	1,183	197	556	34,190	.483	.55
June	860	218	635	37,780	.552	.61
July	391	50	207	12,730	.180	.20
August	526	2	24.9	1,531	.022	.02
September	17	17	17.0	1,012	.015	.01
October	38	8	21.4	1,316	.019	.02
November	38	2	8.0	476	.0070	.01
December	2	2	2.0	123	.0017	.00
The period				106,600		

PINE CREEK NEAR PALISADE, NEV.

This station was established November 27, 1902, by E. C. Murphy. It is located at the Eureka and Palisade Railroad bridge, 1 mile southwest of Palisade, Nev. The gage is a 1 by 4 inch vertical board spiked to the right abutment of the railroad bridge on the downstream side. It is read once each day by T. H. Jewell. Discharge measurements are made from the upstream side of the single-span railroad bridge at which the gage is located. The initial point for soundings is the right abutment. The channel is straight for 40 feet above and for 200 feet below the station. The current has a moderate velocity. The right bank is high and will not overflow. The left bank will overflow at extreme high water. There is but one channel at all stages, but during floods the entire flat on the left bank is under water. The bed of the stream is composed of gravel and sand and is shifting. The bench mark consists of a spike and three nails driven into the abutment near the gage. Its elevation is 7.00 feet above the zero of the gage.

The bed of the stream is so shifting that the station was abandoned December 31, 1904.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Pine Creek near Palisade, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 23	W. A. Wolf	17	9.5	1.72	1.80	16
April 13	do	8	3.5	1.98	1.82	6.9
May 4	do	9	4.7	1.90	1.85	8.9
June 6	do	11	8.3	1.65	1.75	14
June 16	do	10	5.9	1.71	1.65	10
June 27	do	4	1.4	1.43	1.70	2.0
July 8	do	6	2.0	1.50	1.75	3.0
August 17	do	4	1.6	1.17	1.40	1.9

Mean daily gage height, in feet, of Pine Creek near Palisade, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	De-
1	2.20	2.00	2.05	2.30	1.80	1.80	1.70	1.65	1.90	2.10	1.90	1.8
2	2.20	2.00	2.00	2.10	2.20	1.80	1.70	1.70	1.90	2.10	1.90	1.8
3	2.15	1.95	2.00	2.05	2.20	1.80	1.70	1.70	1.90	2.20	1.90	1.8
4	2.10	1.95	2.00	2.00	2.20	1.80	1.70	1.70	1.90	2.20	1.90	1.8
5	2.00	1.90	1.95	2.00	2.30	1.80	1.70	1.70	1.90	2.20	1.90	1.8
6	1.90	1.90	1.95	2.00	2.20	1.75	1.70	1.70	1.90	2.20	1.90	1.8
7	1.80	1.80	1.95	1.90	2.10	1.70	1.70	1.70	1.90	2.20	1.90	1.7
8	1.70	1.85	1.95	1.85	2.10	1.70	1.70	1.70	1.90	2.20	1.90	1.7
9	1.60	1.90	1.95	1.85	2.10	1.65	1.70	1.70	1.90	2.20	1.90	1.7
10	1.60	1.95	1.95	1.85	2.05	1.60	1.65	1.70	1.90	2.25	1.90	1.7
11	1.60	2.00	1.95	1.85	2.05	1.60	1.65	1.65	1.90	2.25	1.90	1.7
12	1.60	2.05	1.95	1.85	2.00	1.60	1.65	1.65	1.90	2.50	1.90	1.7
13	1.60	2.10	1.95	1.85	1.95	1.60	1.65	1.65	1.90	2.50	1.90	1.7
14	1.60	2.00	1.95	1.85	1.90	1.60	1.65	1.70	1.90	2.50	1.90	1.7
15	1.60	2.10	1.95	1.85	1.85	1.60	1.65	1.70	1.90	2.50	1.90	1.7
16	1.60	2.20	1.95	1.80	1.85	1.60	1.65	2.50	1.90	2.35	1.85	1.7
17	1.60	2.50	1.95	1.80	1.85	1.65	1.65	2.50	1.90	2.30	1.85	1.7
18	1.65	2.50	1.95	1.80	1.85	1.65	1.65	2.20	1.90	2.25	1.85	1.7
19	1.70	2.30	1.95	1.70	1.90	1.65	1.65	1.90	1.90	2.20	1.85	1.7
20	1.80	2.20	1.95	1.60	1.90	1.65	1.65	1.80	1.95	2.10	1.85	1.7
21	1.90	2.20	1.95	1.60	1.90	1.65	1.65	1.80	1.95	2.00	1.85	1.7
22	2.00	2.40	1.95	1.60	1.80	1.65	1.65	1.80	2.00	1.90	1.85	1.7
23	2.10	2.90	1.95	1.60	1.80	1.65	1.65	1.75	2.10	1.90	1.85	1.7
24	2.10	3.10	2.00	1.60	1.80	1.65	1.65	1.75	2.10	1.90	1.85	1.7
25	2.10	2.50	2.00	1.60	1.80	1.70	1.65	1.75	2.10	1.90	1.85	1.7
26	2.10	2.30	2.00	1.70	1.80	1.70	1.65	1.75	2.10	1.90	1.85	1.7
27	2.10	2.10	2.00	1.70	1.80	1.70	1.65	1.70	2.10	1.90	1.80	1.7
28	2.10	2.10	2.10	1.70	1.80	1.70	1.65	1.75	2.10	1.90	1.80	1.7
29	2.10	2.10	2.20	1.80	1.80	1.70	1.65	1.80	2.10	1.90	1.80	1.7
30	2.10	.....	2.40	1.80	1.80	1.70	1.65	1.90	2.10	1.90	1.80	1.7
31	2.10	.....	2.50	.....	1.80	.....	1.65	1.90	.....	1.90	.....	1.7

TRUCKEE RIVER NEAR WADSWORTH, NEV.

This station was established November 6, 1902, by E. C. Murphy. It is located one-fourth mile west of the school at the Indian agency and 18 miles north of Wadsworth, Nev. The gage is a 4 by 4 inch vertical timber spiked to a cottonwood tree on the right bank. It is read twice each day by Joshua R. Bennett. Discharge measurements are made by means of a cable and car about 200 feet below the gage. The initial point for soundings is the zero of the tagged wire. The channel is straight for 200 feet above and below the cable and the current is swift. The right bank is low, and is liable to overflow beyond the cable support at very high water. The left bank is high and will not overflow. The bed of the stream is composed of sand and gravel and is permanent. There is but one channel at all stages. The bench mark consists of three nails driven into the root of a cottonwood tree 18 feet north of the gage. Its elevation is 12.07 feet above the zero of the gage. The gage was disturbed by a flood in early February, 1904, and settled 0.31 feet. The elevation of the bench mark is 12.38 feet above the zero of the present gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Truckee River near Wadsworth, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 3	W. A. Wolf	125	786	3.14	7.70	2,466
April 27	do	131	668	3.37	7.46	2,249
May 12	do	128	814	4.49	8.70	3,656
June 3	do	128	792	4.46	8.50	3,532
June 13	do	125	739	3.69	8.00	2,729
June 24	do	130	695	3.39	7.65	2,419
July 11	do	125	562	2.60	6.65	1,462
July 20	do	125	550	2.57	6.55	1,414
July 29	do	125	480	2.04	5.95	978
August 21	do	125	439	2.18	5.65	855
November 17	do	125	463	2.03	5.90	939

Mean daily gage height, in feet, of Truckee River near Wadsworth, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.00	4.60	6.80	.....	7.10	8.68	.....	.....	5.50	6.06	6.20	5.95
2	5.00	4.60	.....	7.85	7.10	8.68	.....	.....	5.50	6.25	6.18	6.00
3	5.00	4.60	7.40	7.75	7.17	8.58	.....	.....	5.49	6.04	6.15	6.00
4	5.00	4.60	7.62	7.66	7.16	8.56	.....	.....	5.41	5.98	6.15	5.92
5	5.15	4.60	.....	7.68	7.25	.....	.....	.....	5.49	6.02	6.10	5.80
6	5.00	4.60	.....	7.74	7.50	8.32	.....	.....	5.51	5.98	6.02	5.80
7	5.00	4.60	7.88	8.19	.....	8.44	.....	5.95	5.49	6.12	6.00	5.80
8	5.00	4.60	7.99	8.16	8.35	8.30	.....	5.85	5.50	5.94	6.00	5.75
9	5.00	4.60	8.26	8.20	8.49	8.28	.....	5.70	5.51	5.98	5.98	5.75
10	5.00	4.60	8.16	8.22	8.45	8.20	.....	5.70	5.47	5.98	5.98	5.80
11	5.00	4.60	8.06	8.46	8.59	8.19	.....	5.72	5.48	6.22	6.00	5.80
12	4.80	4.60	7.75	8.84	8.74	.....	.....	5.71	5.49	7.51	6.00	5.70
13	4.80	5.50	7.35	9.08	8.96	.....	.....	5.70	5.51	7.38	5.98	5.80
14	4.80	5.30	7.09	9.46	9.14	.....	.....	5.72	5.55	6.95	5.90	5.72
15	4.80	5.00	7.00	9.78	9.22	.....	.....	5.72	5.59	6.51	5.88	5.75
16	4.80	5.50	7.37	9.85	9.20	.....	.....	5.72	5.62	6.40	5.90	5.70
17	4.80	6.85	7.90	9.34	9.20	.....	.....	5.70	5.61	6.45	5.85	5.70
18	4.80	6.15	7.82	9.18	9.20	.....	.....	5.65	5.59	6.42	5.82	5.70
19	4.80	6.15	.....	9.06	9.13	.....	.....	5.64	5.65	6.41	5.85	5.70
20	4.60	6.15	9.50	9.08	8.85	.....	.....	5.64	5.72	6.32	5.88	5.75
21	4.60	.....	9.65	8.90	.....	.....	.....	5.60	5.65	6.80	5.95	5.70
22	4.60	7.15	9.54	.....	8.95	.....	.....	5.75	5.70	6.25	5.90	5.70
23	4.60	7.90	8.70	.....	9.11	.....	.....	5.80	5.78	6.25	5.90	5.70
24	4.60	8.50	8.14	7.87	9.24	.....	.....	5.65	5.90	6.20	5.85	5.70
25	4.60	8.70	7.80	7.73	9.28	.....	.....	5.64	6.12	6.19	5.80	5.65
26	4.80	.....	7.70	7.60	9.56	.....	.....	5.70	6.02	6.15	5.85	5.65
27	5.00	9.00	.....	7.42	9.00	.....	.....	5.90	6.00	6.15	5.80	5.80
28	5.00	8.70	.....	7.38	8.78	.....	.....	5.85	6.08	6.10	5.82	5.85
29	4.60	.....	.....	7.26	8.75	.....	.....	5.80	6.00	6.08	5.90	5.80
30	4.80	.....	8.10	7.20	8.72	.....	.....	5.70	6.02	6.05	5.92	5.78
31	4.60	.....	7.86	.....	8.66	.....	.....	5.65	.....	6.12	.....	6.70

NOTE.—Gage heights for entire year refer to new datum.

Rating table for Truckee River near Wadsworth, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.60	304	5.70	816	6.80	1,605	7.90	2,665
4.70	337	5.80	878	6.90	1,689	8.00	2,775
4.80	374	5.90	941	7.00	1,775	8.20	2,995
4.90	413	6.00	1,005	7.10	1,863	8.40	3,215
5.00	455	6.10	1,071	7.20	1,954	8.60	3,435
5.10	498	6.20	1,140	7.30	2,049	8.80	3,655
5.20	543	6.30	1,211	7.40	2,146	9.00	3,875
5.30	592	6.40	1,285	7.50	2,245	9.20	4,095
5.40	643	6.50	1,362	7.60	2,345	9.40	4,315
5.50	698	6.60	1,441	7.70	2,449	9.60	4,535
5.60	756	6.70	1,522	7.80	2,557		

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1904. It is well defined between gage heights 5.90 feet and 9.00 feet. The table has been extended beyond these limits. Above gage height 8.00 feet the rating curve is a tangent, the difference being 110 per tenth.

Estimated monthly discharge of Truckee River near Wadsworth, Nev., for 1904.

[Drainage area, 2,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	520	304	392	24,100	0.184	0.212
February	3,875	304	1,300	74,780	.610	.65
March	4,590	1,605	2,736	168,200	1.28	1.48
April	4,810	1,954	3,132	186,400	1.47	1.64
May	4,491	1,863	3,414	209,900	1.60	1.84
June 1–11	3,523	2,984	3,242	70,730	1.52	.82
July						
August 7–31	973	756	833	41,310	.391	.36
September	1,085	649	799	47,540	.375	.42
October	2,255	966	1,214	74,650	.570	.657
November	1,140	878	974	57,960	.457	.51
December	1,522	786	884	54,360	.415	.478
The period				1,010,000		

NOTE.—From February to June, inclusive, the discharge for several days in each month has been interpolated.

TRUCKEE RIVER AT VISTA, NEV.

This station was originally established August 18, 1899, by L. H. Taylor. It is located 7 miles east of Reno, Nev., and one-fourth mile from the Southern Pacific Railroad station at Vista, Nev. On November 12, 1902, a new gage was installed on the left bank, 150 feet above the railroad bridge, by E. C. Murphy. Its zero has the same elevation as that of the original gage. On April 3, 1903, a new gage was established by D. W. Hays. It is located on the left bank and is a vertical 4 by 4 inch timber established on the same datum as the previous gages. On June 23, 1903, this gage was torn out and moved 3 feet farther into the river, in order to establish it in deeper water. The zero of the gage was lowered 2.72 feet. The gage is read once each day by M. Tuomey. Discharge measurements are made by means of a cable and car below the railroad bridge. The initial point for soundings is the zero of the tagged wire. The channel is straight for 150 feet above and 400 feet below the station. Both banks are high. The left bank is liable to overflow only at extreme high stages. There is but one channel at all stages. The bench mark is the head of a bolt set in the concrete on the upstream side of the left abutment of the Southern Pacific Railroad bridge, 300 feet from the gage. Its elevation is 19.74 feet above the zero of the gage.

On February 21, 1904, the gage rod was washed out by a flood. A new gage was established in the same position as the old gage, but with its zero 18.20 feet below bench mark.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Truckee River at Vista, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 11	W. A. Wolf	116	772	4.09	7.78	3,156
April 5	do	115	727	3.95	7.40	2,874
April 8	do	119	861	4.22	8.00	3,634
April 16	do	120	1,302	5.74	10.10	7,480
April 25	do	119	699	3.96	7.30	2,769
April 29	do	121	702	3.54	7.00	2,483
May 10	do	122	1,003	4.90	8.90	4,913
May 24	do	122	1,188	5.48	9.40	6,515
June 4	O. F. Heizer	126	932	4.12	8.40	3,832
June 11	do	120	814	3.91	8.00	3,185
June 18	do	117	756	3.77	7.60	2,849
June 25	do	113	664	3.19	7.00	2,119
July 2	do	129	662	3.01	6.70	1,993

Discharge measurements of Truckee River at Vista, Nev., in 1904—Continued.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
July 9	O. F. Heizer.	120	570	2.61	6.20	1,4[illegible]
July 16	....do	118	535	2.28	5.80	1,2[illegible]
July 19	....do	118	589	2.26	5.90	1,3[illegible]
July 23	....do	117	524	2.16	5.70	1,1[illegible]
July 30	....do	117	490	1.80	5.20	[illegible]
August 7	....do	117	490	1.76	5.10	[illegible]
August 13	....do	116	485	1.53	4.90	[illegible]
August 20	....do	116	470	1.70	5.00	[illegible]
August 28	....do	116	488	1.69	5.10	[illegible]
September 7	W. A. Wolf..	115	466	1.58	4.90	[illegible]
November 14	....do	116	489	1.62	5.25	[illegible]

Mean daily gage height, in feet, of Truckee River at Vista, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.40	4.10	6.20	7.70	7.10	8.10	6.80	5.00	4.80	5.30	5.50	[illegible]
2	4.40	4.10	6.50	7.50	7.10	7.80	6.70	5.00	4.80	5.40	5.50	[illegible]
3	4.40	4.10	7.50	7.50	7.10	8.60	6.60	5.00	4.80	5.40	5.50	[illegible]
4	4.50	4.20	7.60	7.40	7.30	8.40	6.50	4.90	4.80	5.30	5.50	[illegible]
5	4.40	4.20	7.20	7.40	7.60	8.40	6.50	5.00	4.90	5.20	5.40	[illegible]
6	4.40	4.20	6.90	7.70	8.60	8.50	6.40	5.20	4.80	5.30	5.40	[illegible]
7	4.40	4.20	7.60	7.90	8.60	8.50	6.30	5.10	4.80	5.00	5.40	[illegible]
8	4.50	4.20	8.60	8.00	8.60	8.30	6.30	5.10	4.80	5.30	5.40	[illegible]
9	4.50	4.20	7.90	8.20	8.60	8.20	6.20	5.00	4.80	5.10	5.30	[illegible]
10	4.40	4.20	8.40	8.70	8.90	8.00	6.10	4.90	4.80	5.40	5.30	[illegible]
11	4.20	4.20	7.70	9.00	9.00	8.00	6.00	4.90	4.80	5.60	5.30	[illegible]
12	4.20	5.00	7.20	9.40	9.30	8.00	5.90	4.90	4.80	6.80	5.30	[illegible]
13	4.30	4.90	6.70	9.80	9.60	8.00	5.90	4.90	4.80	6.10	5.30	[illegible]
14	4.30	4.50	6.60	10.50	9.70	7.90	5.90	4.90	4.80	5.80	5.30	[illegible]
15	4.30	4.70	6.60	10.70	9.70	7.80	5.80	4.90	4.90	5.90	5.30	[illegible]
16	4.30	7.00	6.90	10.10	9.70	7.80	5.80	4.90	4.95	5.80	5.20	[illegible]
17	4.10	6.00	8.10	9.50	9.70	7.70	5.70	4.90	4.90	5.70	5.20	[illegible]
18	4.20	5.30	8.10	9.30	9.50	7.60	5.80	4.90	5.00	5.60	5.30	[illegible]
19	4.20	5.10	9.10	9.40	9.00	7.50	5.90	4.90	4.90	5.70	5.30	[illegible]
20	4.30	4.90	10.40	8.30	8.70	7.40	5.70	4.90	4.90	5.60	5.20	[illegible]
21	4.20	4.80	9.40	8.10	8.70	7.40	5.60	4.90	4.90	5.60	5.20	[illegible]
22	4.20	8.30	8.80	7.90	8.80	7.40	5.70	4.80	5.00	5.60	5.20	[illegible]
23	4.20	9.30	8.20	7.50	8.90	7.40	5.70	4.80	5.10	5.20	5.20	[illegible]
24	4.20	[a]9.30	7.50	7.40	9.10	7.20	5.60	4.90	5.40	5.10	5.20	[illegible]
25	4.20	[a]9.40	7.40	7.30	10.00	7.00	5.60	4.90	5.40	5.00	5.20	[illegible]
26	4.20	9.40	7.20	7.40	9.60	7.00	5.50	5.00	5.30	5.30	5.10	[illegible]
27	4.20	8.30	7.20	7.10	8.90	6.90	5.40	5.10	5.30	5.40	5.20	[illegible]
28	4.20	7.10	8.60	7.00	8.90	6.90	5.30	5.00	5.30	5.50	5.20	[illegible]
29	4.20	6.30	9.30	7.00	8.80	6.90	5.20	4.90	5.30	5.50	5.30	[illegible]
30	4.20	.....	8.50	7.00	8.70	6.90	5.20	4.90	5.30	5.50	5.30	[illegible]
31	4.10	.....	7.90	.....	8.50	.....	5.10	5.10	.....	5.50	.....	[illegible]

[a] Interpolated.

NOTE.—Gage heights for entire year refer to new datum.

Rating table for Truckee River at Vista, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.10	535	5.60	1,085	7.10	2,360	8.60	4,485
4.20	553	5.70	1,147	7.20	2,470	8.70	4,675
4.30	574	5.80	1,212	7.30	2,585	8.80	4,870
4.40	598	5.90	1,282	7.40	2,705	8.90	5,070
4.50	624	6.00	1,355	7.50	2,830	9.00	5,270
4.60	652	6.10	1,432	7.60	2,955	9.20	5,670
4.70	683	6.20	1,512	7.70	3,085	9.40	6,090
4.80	716	6.30	1,595	7.80	3,220	9.60	6,520
4.90	751	6.40	1,681	7.90	3,360	9.80	6,960
5.00	789	6.50	1,770	8.00	3,505	10.00	7,400
5.10	830	6.60	1,862	8.10	3,655	10.20	7,840
5.20	874	6.70	1,957	8.20	3,810	10.40	8,280
5.30	922	6.80	2,055	8.30	3,970	10.60	8,720
5.40	973	6.90	2,155	8.40	4,135		
5.50	1,027	7.00	2,255	8.50	4,305		

The above table is applicable only for open-channel conditions. It is based upon 23 discharge measurements made during 1904. It is well defined between gage heights 4.90 and 6.70 feet. Above 6.70 feet gage height the measurements are too scattered for an accurate curve.

Estimated monthly discharge of Truckee River at Vista, Nev., for 1904.

[Drainage area, 1,519 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	624	535	572	35,170	0.377	0.435
February	6,090	535	1,777	102,200	1.17	1.26
March	8,280	1,512	3,431	211,000	2.26	2.61
April	8,940	2,255	4,172	248,200	2.75	3.07
May	7,400	2,360	4,924	302,800	3.24	3.74
June	4,485	2,155	3,174	188,900	2.09	2.33
July	2,055	830	1,313	80,730	.864	.996
August	874	716	771	47,410	.508	.586
September	973	716	785	46,710	.517	.577
October	2,055	789	1,049	64,500	.691	.797
November	1,027	830	924	54,980	.608	.678
December	1,355	789	844	51,900	.556	.641
The year	8,940	535	1,978	1,435,000	1.30	17.72

TRUCKEE RIVER AT NEVADA-CALIFORNIA STATE LINE.

This station was originally established September 7, 1899, by L. H. Taylor. It is located at the State line, 17 miles west of Reno, Nev. The original gage was vertical, driven into the bed of the river and wired to a granite bowlder. On November 11, 1902, a new gage was established by E. C. Murphy. It is located on the right bank, 400 feet below the point at which the old gage was located, and consists of two sections of 4 by 4 inch timber. The upper section is vertical, and is spiked to a cottonwood tree. The lower section is inclined, and is immediately under the vertical section. The gage datum is the same as that of the old gage. The gage is read once each day by H. E. Dickinson. Discharge measurements are made by means of a cable and car 2½ miles below the gage at Linham Siding, and 100 feet below Bridge No. 2. The initial point for soundings is the zero of the tagged wire. The channel is straight for 60 feet above and for 75 feet below the cable. The current is swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of bowlders and cobblestones. The bench mark consists of two spikes driven into the root of the cottonwood tree, to which the vertical section of the gage is attached. Its elevation is 5.99 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Truckee River at Nevada-California State line, in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis-charge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 6	W. A. Wolf	96	539	4.67	4.40	2,5[illegible]
April 23	do	90	470	4.85	4.20	2,2[illegible]
May 11	do	92	653	5.96	5.75	3,8[illegible]
May 31	do	91	452	4.82	4.10	2,1[illegible]
June 14	do	91	523	5.69	4.80	2,9[illegible]
June 18	do	91	533	5.49	4.60	2,9[illegible]
July 1	O. F. Heizer	91	473	4.17	3.95	1,9[illegible]
July 14	do	83	416	3.51	3.35	1,4[illegible]
August 4	do	80	368	3.01	2.95	1,1[illegible]
August 18	do	80	360	2.92	2.85	1,0[illegible]
August 31	W. A. Wolf	80	313	2.68	2.70	8[illegible]
November 19	do	80	321	2.65	2.70	8[illegible]

Mean daily gage height, in feet, of Truckee River, at Nevada-California State line, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.06	1.90	3.15	4.22	4.15	4.85	3.95	3.00	2.65	2.95	2.85	2.75
2	2.00	2.00	3.25	4.10	4.15	5.30	3.80	.....	2.65	2.80	2.95	2.75
3	2.00	1.95	4.25	4.15	4.15	5.35	3.70	3.00	2.65	2.75	2.85	2.74
4	2.50	1.90	4.20	4.15	4.40	5.22	3.80	2.95	.....	2.75	2.80	.....
5	2.30	1.85	4.00	4.20	4.68	.....	3.80	3.15	2.95	2.78	2.80	2.75
6	2.30	1.90	3.88	4.60	4.95	5.25	3.72	3.00	2.65	2.80	2.80	2.75
7	2.15	2.00	4.77	4.40	5.35	5.00	3.58	2.85	2.70	2.52	2.80	2.70
8	2.12	2.00	5.00	.....	5.35	4.85	3.60	2.92	2.70	2.55	2.78	2.60
9	2.15	2.00	4.30	4.65	5.35	4.85	3.55	.....	2.72	2.60	2.80	2.65
10	2.15	2.00	4.20	5.05	5.68	4.85	3.50	2.90	2.70	.....	.....	2.65
11	1.95	1.90	4.00	5.45	5.75	4.82	3.45	2.90	2.72	3.75	2.85	2.60
12	1.92	2.05	3.85	5.75	5.95	4.78	3.40	2.90	2.70	3.40	2.68	2.60
13	1.90	1.90	3.85	6.20	6.12	4.75	3.20	2.85	.....	3.10	2.65	2.60
14	2.00	2.05	3.55	6.48	6.50	4.75	3.40	.....	2.80	2.95	2.60	2.60
15	2.05	2.05	3.50	6.25	6.08	4.75	3.38	2.90	2.70	3.05	2.60	2.60
16	2.10	3.80	3.65	5.70	6.02	4.72	3.30	2.90	2.70	3.10	2.65	2.60
17	2.05	3.60	3.90	5.42	6.02	4.65	3.35	2.85	2.75	3.10	2.65	2.50
18	2.00	2.85	5.15	5.42	5.72	4.60	3.35	2.90	2.75	3.00	.....	2.50
19	1.95	2.80	6.20	5.45	5.30	4.40	3.25	2.90	2.80	.....	2.70	2.50
20	1.80	2.60	6.50	4.85	5.28	4.30	3.30	2.90	2.80	2.85	.....	2.60
21	2.00	2.50	4.92	4.58	5.40	4.30	3.30	3.15	2.75	2.90	2.70	2.60
22	2.00	4.95	4.90	4.40	6.10	4.47	3.30	2.85	2.75	2.90	2.70	2.55
23	1.90	6.30	4.50	4.22	6.15	4.35	3.25	2.75	2.75	2.62	2.65	2.55
24	1.95	8.00	4.05	4.15	6.20	4.35	3.25	2.75	2.70	2.60	2.62	2.55
25	1.90	5.50	3.90	4.15	6.42	4.15	3.25	2.75	2.85	2.55	2.60	2.55
26	2.00	5.00	3.90	3.95	5.95	.....	3.25	2.75	.....	2.55	2.60	2.55
27	1.80	4.00	3.85	4.10	5.12	4.08	.....	2.70	2.65	2.55	2.70	2.55
28	1.85	3.50	5.10	4.02	5.28	4.10	3.15	2.70	.....	2.90	2.75	2.55
29	1.60	3.15	5.35	4.05	5.30	4.10	3.15	2.70	2.75	2.90	2.70	2.55
30	1.75	.....	5.12	4.02	5.40	4.05	3.00	2.70	2.75	2.90	2.65	3.30
31	1.90	.....	4.28	.....	5.25	.....	2.95	2.65	.....	2.90	.....	2.85

Rating table for Truckee River at Nevada-California State line, from January 1 to [illegible] 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	230	2.80	956	4.00	2,070	5.20	3,370
1.70	271	2.90	1,040	4.10	2,170	5.30	3,490
1.80	314	3.00	1,126	4.20	2,270	5.40	3,610
1.90	361	3.10	1,213	4.30	2,370	5.50	3,730
2.00	412	3.20	1,302	4.40	2,470	5.60	3,850
2.10	467	3.30	1,393	4.50	2,580	5.70	3,970
2.20	526	3.40	1,486	4.60	2,690	5.80	4,090
2.30	589	3.50	1,580	4.70	2,800	5.90	4,210
2.40	656	3.60	1,676	4.80	2,910	6.00	4,330
2.50	725	3.70	1,772	4.90	3,020	6.20	4,570
2.60	798	3.80	1,870	5.00	3,130	6.40	4,810
2.70	875	3.90	1,970	5.10	3,250		

The above table is applicable only for open-channel conditions. It is based [illegible] 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.10 feet and 5.75 feet. The table has been extended beyond these limits. Above gage height 5.00 feet the rating curve is a tangent, the difference being 120 per tenth.

Estimated monthly discharge of Truckee River at Nevada-California State line, for 1904.

[Drainage area, 955 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	[illegible]
January	725	230	419	25,760	0.439	[illegible]
February	6,730	337	1,351	77,710	1.41	[illegible]
March	4,930	1,257	2,469	151,800	2.59	[illegible]
April	4,906	2,020	2,897	172,400	3.03	[illegible]
May	4,930	2,220	3,706	227,900	3.88	[illegible]
June	3,550	2,120	2,751	163,700	2.88	[illegible]
July	2,020	1,083	1,497	92,050	1.57	[illegible]
August	1,257	836	1,017	62,530	1.06	[illegible]
September	1,083	836	903	53,730	.946	[illegible]
October	1,821	739	1,029	63,270	1.08	[illegible]
November	1,083	798	893	53,140	.935	[illegible]
December	1,393	725	834	51,280	.873	[illegible]
The year	6,730	230	1,647	1,195,000	1.72	[illegible]

NOTE.—Missing gage heights interpolated.

TRUCKEE RIVER AT TAHOE, CAL.

Truckee River, the natural outlet of Lake Tahoe, leaves the lake at the city of Tahoe. About 500 feet from the lake there is a timber dam across the river, which has been maintained for more than twenty years, for the purpose of controlling the discharge from the lake. June 17, 1900, a gage was placed in the stream for the purpose of recording the height of the water in the river. The gage is a vertical timber driven into the stream bed at the left bank about 300 feet below the dam, and is spiked to the root of a cottonwood tree growing on the bank. On November 18, 1902, a new gage was established by E. C. Murphy in the exact position of the old gage. It is a 4 by 4 inch vertical timber. The elevation of its zero is the same as that of the old gage. The bench mark is cut in the side of the tree and is 4.00 feet above gage datum. The measurements are made from a cable and car about one-fourth mile below the gage, which was placed as near the city of Tahoe as possible for the convenience of the observer. At the point of measurement the right bank is low and is subject to overflow at very high stages of the stream. The left bank is rather high. The channel is nearly straight for 300 feet above and below the station, and the bed of the river, which is of gravel and coarse sand, is smooth and stable. The current has a moderate velocity. During June, 1904, a new cable was put in 1 mile below the gage. The purpose of the station is to ascertain the actual overflow from Lake Tahoe with a view to determining its real value as a storage reservoir.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Truckee River at Tahoe, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 20	W. A. Wolf	118	306	2.93	3.50	899
July 2	do	118	306	2.86	3.35	875
July 14	do	118	363	2.42	3.35	879
July 22	do	118	351	2.44	3.35	856
August 14	do	118	344	2.38	3.20	818
August 30	do	118	308	2.18	2.85	674
November 15	do	118	314	2.26	2.90	711

Mean daily gage height, in feet, of Truckee River at Tahoe, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	D
1	1.90	1.40	0.10	2.50	3.10	3.55	3.50	3.30	2.85	3.00	3.00	2
2	1.90	1.40	.10	2.50	3.10	3.45	3.40	3.30	2.85	3.10	3.00	2
3	1.90	1.40	.10	2.50	3.10	3.35	3.40	3.30	2.95	3.10	3.00	2
4	1.90	1.40	.10	2.50	3.10	3.30	3.40	3.30	3.45	3.10	3.00	2
5	1.90	1.40	.10	2.50	3.10	3.40	3.40	3.30	2.85	3.10	3.00	2
6	1.90	1.40	1.30	2.50	3.10	3.40	3.40	3.25	3.00	2.20	3.00	2
7	1.90	.40	1.30	2.50	3.10	3.40	3.40	3.25	3.00	2.20	3.00	2
8	1.90	.40	1.30	2.50	3.10	3.40	3.40	3.25	3.15	2.20	3.00	2
9	1.90	.40	1.30	2.50	3.10	3.40	3.40	3.25	3.15	2.20	3.00	2
10	1.40	.40	1.90	2.50	3.10	3.40	3.30	3.25	3.15	2.20	3.00	2
11	1.40	.40	1.90	2.50	3.10	3.40	3.30	3.25	3.15	2.20	3.00	2
12	1.70	.90	1.90	2.50	3.10	3.40	3.30	3.25	3.15	2.50	3.00	2
13	1.60	1.50	1.90	2.50	3.10	3.40	3.30	3.25	3.15	2.50	3.00	2
14	1.60	.60	1.90	2.50	3.10	3.40	3.40	3.20	3.15	3.10	3.00	2
15	1.60	.60	2.50	2.50	3.10	3.50	3.40	3.30	3.10	3.10	3.00	2
16	1.60	1.01	2.50	2.50	3.10	3.50	3.40	3.30	3.10	3.10	2.90	2
17	1.60	1.01	2.50	2.60	3.15	3.50	3.50	3.30	3.10	3.10	2.90	2
18	1.60	1.01	2.50	2.60	3.15	3.50	3.50	3.30	3.00	3.00	2.85	2
19	1.40	.90	2.50	2.60	3.15	3.55	3.45	3.20	3.10	3.00	2.85	2
20	1.40	.90	2.50	2.60	3.15	3.55	3.45	3.20	3.10	3.15	2.85	2
21	1.40	.10	2.50	2.60	3.15	3.55	3.40	3.20	3.10	3.15	2.85	2
22	1.40	.10	2.50	2.60	3.15	3.55	3.40	2.90	3.10	2.40	2.85	2
23	1.40	.10	2.50	2.60	3.15	3.55	3.40	2.90	3.10	2.40	2.85	2
24	1.40	.10	2.50	2.70	3.30	3.50	3.40	2.90	3.10	2.40	2.80	2
25	1.40	.10	2.50	2.80	3.30	3.50	3.40	2.90	3.00	2.80	2.80	2
26	1.40	.10	2.50	2.80	3.30	3.40	3.35	2.90	3.00	2.80	2.80	2
27	1.40	.10	2.30	2.80	3.25	3.50	3.35	2.90	3.00	3.10	2.80	2
28	1.40	.10	2.30	2.80	3.25	3.50	3.35	2.90	3.00	3.10	2.80	2
29	1.40	.10	2.30	3.10	3.25	3.50	3.35	2.85	3.00	3.10	2.80	2
30	1.40	.....	2.40	3.10	3.55	3.50	3.35	2.85	3.00	3.10	2.80	2
31	1.40	.....	2.40	.....	3.55	.....	3.35	2.85	.....	3.10	.....	.....

[a] Interpolated.

Rating table for Truckee River at Tahoe, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	13	1.10	181	2.10	450	3.10	77
0.20	24	1.20	204	2.20	480	3.20	8
0.30	37	1.30	228	2.30	510	3.30	84
0.40	51	1.40	253	2.40	542	3.40	87
0.50	66	1.50	279	2.50	574	3.50	91
0.60	82	1.60	305	2.60	606	3.60	94
0.70	100	1.70	333	2.70	638	3.70	98
0.80	119	1.80	361	2.80	671	3.80	1,02
0.90	139	1.90	390	2.90	705	3.90	1,05
1.00	159	2.00	420	3.00	739		

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 0.10 foot and 3.50 feet. The table has been extended above gage height 3.50 feet.

Estimated monthly discharge of Truckee River at Tahoe, Cal., for 1904.

[Drainage area, 519 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	390	253	305	18,750	0.588	0.678
February	253	13	111	6,385	.214	.231
March	574	13	401	24,660	.773	.891
April	773	574	610	36,300	1.18	1.32
May	931	773	799	49,130	1.54	1.78
June	931	841	899	53,490	1.73	1.93
July	913	841	873	53,680	1.68	1.94
August	841	688	787	48,390	1.52	1.75
September	895	688	761	45,280	1.47	1.64
October	790	480	672	41,320	1.29	1.49
November	739	671	711	42,310	1.37	1.53
December	671	590	614	37,750	1.18	1.36
The year	931	13	629	457,400	1.21	16.54

LAKE WINNEMUCCA INLET NEAR WADSWORTH, NEV.

This station was established November 7, 1902, by E. C. Murphy. It is located 3 miles north of Pyramid Lake Indian School and 21 miles north of Wadsworth, Nev. The gage is a 4 by 4 inch vertical timber spiked to a willow tree on the right bank. It is read three times each week by J. R. Bennett. The discharge measurements are made by means of a cable and car near the gage. The initial point for soundings is the zero of the tagged wire. The channel is straight for 150 feet above and below the cable, and the current is moderate. Both banks are high and not subject to overflow. The bed is composed of gravel and silt and may change slightly. There is but one channel at all stages. The bench mark consists of two spikes driven into the willow tree to which the gage is attached. Its elevation is 6.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Lake Winnemucca Inlet near Wadsworth, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis-charge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second*
March 15	W. A. Wolf	51	143	1.68	4.50	2
April 4	do	53	185	1.93	5.00	3
May 12	do	58	226	1.93	7.22	4
June 3	do	53	228	2.00	6.00	4
June 13	do	53	183	1.92	5.00	3
June 24	do	51	151	1.92	4.40	2
July 11	do	44	93	1.47	2.90	1
July 20	do	43	83	1.42	2.70	1
July 29	do	42	71	1.26	2.50	
August 21	do	41	65	1.26	2.40	
November 18	do	44	95	1.40	3.00	1

Mean daily gage height, in feet, of Lake Winnemucca Inlet near Wadsworth, Nev., for 1

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	D
1			2.20	5.90	6.77	5.00					2.88	
2		1.60					2.20		2.75	2.77		
3	1.80			4.55	6.55	6.77						
4			1.90	5.00					2.70	2.90	2.70	
5	1.88	1.88		4.99		6.40	2.30					
6			1.70		5.66				2.68	2.66	2.88	
7		1.66				6.50				2.99		
8	1.50		5.88	5.77	4.55		2.40				2.80	
9		1.80						2.80		2.99		
10	1.55			8.66	4.88	6.35	3.00		2.68			
11			5.70							2.99	2.77	
12	1.88	1.77		8.99	7.22	6.00	3.80	2.80				
13			5.66		5.66				2.88	2.88	2.60	
14		1.55				5.77				2.77		
15	1.80		5.99	6.55	4.99		3.40				2.88	
16		1.77						2.66		2.99		
17	1.99			4.88	4.77	5.55	2.70		2.99		2.99	
18			3.80						2.77	2.77	2.99	
19	1.77	5.88		8.77			2.60	2.66		2.90	2.66	
20			2.50		5.66				2.70		2.88	
21		6.77						2.74		2.88	2.66	
22	1.88		4.66	5.88	5.77		2.50					
23		2.66						2.88	2.77	2.56	2.88	
24	1.70			5.66	6.99		2.50				2.77	
25			5.77					2.90		2.70		
26	1.60	2.77		6.55			2.50		2.86			
27			4.70		8.77			2.99		2.88	2.99	
28		2.99							2.88			
29	1.88		6.55	5.99	8.55		2.40	2.88		2.66	2.88	
30									2.88		2.66	
31	1.66				7.66		2.30	2.77				

ating table for Lake Winnemucca Inlet near Wadsworth, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	16	3.00	145	4.50	300	6.00	458
1.60	22	3.10	155	4.60	311	6.20	479
1.70	28	3.20	165	4.70	321	6.40	500
1.80	34	3.30	175	4.80	332	6.60	522
1.90	41	3.40	185	4.90	342	6.80	544
2.00	49	3.50	196	5.00	353	7.00	565
2.10	57	3.60	206	5.10	363	7.20	586
2.20	65	3.70	217	5.20	374	7.40	607
2.30	74	3.80	227	5.30	384	7.60	629
2.40	84	3.90	237	5.40	395	7.80	650
2.50	94	4.00	248	5.50	405	8.00	672
2.60	104	4.10	258	5.60	416	8.20	693
2.70	114	4.20	269	5.70	426	8.40	714
2.80	124	4.30	279	5.80	437	8.60	735
2.90	134	4.40	290	5.90	447	8.80	756

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904. It is well defined between gage heights 20 feet and 6.00 feet. The table has been extended beyond these limits.

stimated monthly discharge of Lake Winnemucca Inlet near Wadsworth, Nev., for 1904.

Month.	Mean discharge in second-feet.	Total in acre-feet.[a]
nuary, 13 days	31.9	1,961
ebruary, 12 days	130	7,478
arch, 13 days	292	17,950
pril, 14 days	490	29,160
ay, 15 days	490	30,130
ne, 14 days	365	21,720
ly, 13 days	111	6,825
ugust, 10 days	125	7,686
ptember, 12 days	124	7,379
ctober, 16 days	127	7,809
ovember, 17 days	126	7,498
ecember, 19 days	117	7,194
The year	.....	152,800

[a] Acre-feet computed for entire month.

LITTLE TRUCKEE RIVER NEAR PINE STATION, CAL.

The station was established June 25, 1903, by George B. Lorenz. The cable station is located about one-fourth of a mile upstream from Bruhn's mill, known also as Pine Station. The dam at this point backs the water up for about 300 yards. The road which follows the Little Truckee north from Boca crosses the river at a ford about 150 feet below the cable and the same distance above the gage rod. Pine Station, on the Boca and Loyalton Railroad, about one-fourth of a mile distant, is the nearest railroad point. The gage rod is located about 300 feet below the cable, and consists of a vertical 2 by 6 inch board graduated to feet and tenths from zero to 4 feet. The gage is read twice each day by S. Wallace. Discharge measurements are made from a three-eighths inch steel cable and car, 5½ feet above the high-water level. A tag wire is stretched just above the cable. The initial point for soundings is the post which supports the cable on the left or north bank. Above the station the channel is straight for 100 feet at high water and for 30 feet at low water. Below the station the channel is straight for 200 feet at high and low water. The current is swift at all stages. The right or south bank is high, steep, and rocky, and is not subject to overflow. It supports some underbrush and a few trees. The left or north bank is composed of gravel for 40 feet back from the high-water channel. It is low and may be overflowed. The bed of the stream consists of coarse gravel and is free from vegetation. There is but one channel at all stages.

The bench mark is the head of a large nail driven into a 2 by 4 inch timber set in the ground in a clump of small willows 8 feet from the gage. The willows surrounding the bench mark are blazed and marked "B. M., U. S. G. S." Its elevation is 4.83 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Little Truckee River near Pine Station, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 27	W. A. Wolf	90	215	4.52	3.10	971
June 12	do	84	194	3.90	2.90	757
June 21	do	74	153	4.03	2.50	617
July 5	do	68	108	2.97	1.88	321
July 16	do	65	92	2.01	1.60	185
August 12	do	55	44	1.08	.85	48
September 1	do	55	41	1.02	.75	42

Mean daily gage height, in feet, of Little Truckee River near Pine Station, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.12	1.44	2.50	2.69	2.46	2.94	2.16	1.04	0.65	1.02	1.00	1.26
2	1.12	1.40	2.80	2.70	2.48	2.92	2.08	1.06	.65	.94	1.00	1.22
3	1.25	1.40	2.82	2.66	2.55	3.06	2.04	1.03	.63	.82	1.00	1.13
4	1.30	1.45	2.85	2.72	2.76	2.98	1.96	1.02	.63	.80	.98	1.10
5	1.40	1.37	2.72	2.82	2.94	2.99	1.88	1.00	.63	.78	.95	1.07
6	1.38	1.42	2.75	2.92	3.16	3.06	1.90	.99	.63	.80	.94	1.12
7	1.40	1.45	2.90	3.09	3.20	3.05	1.92	.98	.62	.95	.92	1.10
8	1.50	1.53	3.10	3.23	3.30	2.86	1.88	.95	.60	.99	.90	1.14
9	1.45	1.60	2.82	3.49	3.32	2.85	1.80	.93	.60	1.04	.90	1.00
10	1.18	1.60	2.75	3.64	3.46	2.84	1.76	.92	.60	1.28	.89	.90
11	1.28	1.60	2.45	3.84	3.44	2.85	1.64	.85	.60	2.34	.88	.75
12	1.30	1.50	2.32	4.07	3.60	2.78	1.60	.83	.60	2.16	.88	.76
13	1.25	1.40	2.29	4.48	3.75	2.80	1.56	.82	.60	1.80	.86	.78
14	1.32	1 54	2.28	4.56	3.64	2.84	1.59	.80	.60	1.58	.85	.76
15	1.48	1.90	2.25	4.32	3.64	2.75	1.56	.83	.62	1.36	.90	.75
16	1.42	2.42	2.18	3.95	3.60	2.72	1.62	.80	.63	1.28	.86	.68
17	1.42	2.58	2.35	3.74	3.56	2.65	1.56	.80	.63	1.20	.88	.85
18	1.36	2.54	2.95	3.86	3.38	2.60	1.52	.80	.66	1.12	.92	.86
19	1.40	2.56	3.55	3.72	3.12	2.50	1.48	.78	.63	1.10	.86	.78
20	1.52	2.28	3.65	3.15	3.08	2.44	1.42	.76	.63	1.06	.89	.78
21	1.48	2.18	3.35	2.95	3.22	2.45	1.39	.73	.60	1.05	.86	.76
22	1.56	2.75	3.06	2.80	3.48	2.46	1.38	.70	.68	1.04	.88	.73
23	1.48	3.25	2.82	2.60	3.62	2.48	1.32	.70	.82	1.04	.84	.68
24	1.48	3.75	2.60	2.55	3.73	2.39	1.32	.79	1.08	1.03	.85	.54
25	1.42	3.65	2.49	2.59	3.82	2.29	1.33	.84	.95	1.03	.85	.60
26	1.39	3.35	2.45	2.58	3.82	2.20	1.26	.80	.89	1.03	.86	.78
27	1.40	2.90	2.50	2.44	3.08	2.22	1.22	.74	.84	1.03	.95	1.14
28	1.39	2.62	3.08	2.34	3.02	2.26	1.18	.72	.80	1.00	1.05	1.24
29	1.38	2.60	3.14	2.35	3.06	2.26	1.13	.69	.80	1.00	.99	1.15
30	1.40	.....	2.89	2.45	3.10	2.22	1.10	.68	.82	1.00	1.14	1.50
31	1.38	.....	2.76	.....	3.04	.....	1.06	.66	.....	1.00	.....	1.14

Rating table for Little Truckee River near Pine Station, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	31	1.70	240	2.70	708	3.70	1,265
.70	37	1.80	278	2.80	761	3.80	1,325
.80	45	1.90	318	2.90	815	3.90	1,385
.90	53	2.00	361	3.00	869	4.00	1,445
1.00	64	2.10	407	3.10	923	4.10	1,510
1.10	79	2.20	455	3.20	978	4.20	1,575
1.20	98	2.30	504	3.30	1,034	4.30	1,640
1.30	120	2.40	554	3.40	1,090	4.40	1,705
1.40	145	2.50	604	3.50	1,146	4.50	1,770
1.50	174	2.60	656	3.60	1,205	4.60	1,835
1.60	205						

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined between gage heights 0.75 foot and 3.10 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Little Truckee River near Pine Station, Cal, for 1904.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	192	83	140	8,608	0.843	0.97
February	1,295	137	467	26,860	2.81	3.0
March	1,235	445	742	45,620	4.47	5.1
April	1,809	524	981	58,370	5.91	6.5
May	1,337	584	1,013	62,290	6.10	7.0
June	901	455	688	40,940	4.14	4.6
July	436	73	209	12,850	1.26	1.4
August	73	35	49.3	3,031	.297	.3
September	76	31	37.8	2,249	.228	.2
October	536	43	115	7,071	.693	.7
November	86	48	55.6	3,308	.335	.3
December	174	28	64.6	3,972	.389	.4
The year	1,809	28	380	275,090	2.29	31.0

INDEPENDENCE CREEK BELOW INDEPENDENCE LAKE, CAL.

This station was established October 24, 1902, by E. C. Murphy. It is located about one-eighth of a mile below the dam at the lower end of Independence Lake, California. The original gage was a vertical 4 by 4 inch timber, located about 200 feet upstream from the cable and car from which the measurements are made. For the convenience of the observer, a new vertical gage, made of 2 by 4 inch timber, was established July 1, 1904, on the left bank of the stream 75 feet below the outlet of the lake. Simultaneous readings taken upon the two gages give identical results for the fluctuations of 1904. The gage is read twice daily by F. A. Connor. The channel is straight for 50 feet above and below the station. The banks are low but not subject to overflow. The bed of the stream is permanent, being composed of gravel and clay, but during high water large quantities of sand are washed down the stream. The current is moderately rapid, and the discharge is controlled by the dam at the end of the lake. The bench mark for the original gage is three nails driven in the root of a pine tree 55 feet northwest of the gage. Its elevation is 5.82 feet above the zero of the gage. The bench mark for the new gage is the head of four nails driven into the tree stump to which the new gage rod is fastened. Its elevation is 3.00 feet above the zero of the new gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Independence Creek below Independence Lake, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec.-feet.*
June 17	A. E. Chandler	29	62	1.98	3.15	123
July 1	W. A. Wolf	28	60	1.62	3.08	97
July 13	do	28	52	.90	2.75	47
July 23	do	13	7.8	1.69	2.30	13
August 29	do	6	3.0	.77	1.80	3
November 16	do	6	4.2	1.23	2.05	5

Mean daily gage height, in feet, of Independence Creek below Independence Lake, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.52	1.69	2.69	2.13	2.12	3.15	3.10	2.25	1.80	1.80	2.15	[illegible]
2	1.55	1.69	2.47	2.12	2.14	3.12	3.02	2.25	1.80	1.80	2.10	[illegible]
3	1.52	1.70	2.26	2.11	2.14	3.10	3.00	2.25	1.80	1.80	2.10	[illegible]
4	1.60	1.70	2.30	2.10	2.18	3.14	2.95	2.25	1.80	1.80	2.10	[illegible]
5	1.59	1.72	2.30	2.10	2.18	3.15	2.88	2.25	1.80	1.85	2.10	[illegible]
6	1.59	.....	2.30	2.10	2.39	3.20	2.85	2.25	1.80	1.90	2.10	[illegible]
7	1.59	.....	2.30	2.10	2.66	3.31	2.85	2.25	1.80	1.98	2.10	[illegible]
8	1.59	.....	2.56	2.10	3.08	3.34	2.85	2.25	1.80	2.00	2.00	[illegible]
9	1.59	.....	2.78	2.10	3.05	3.31	2.85	2.25	1.80	2.35	2.00	[illegible]
10	1.59	1.98	.....	2.10	3.05	3.25	2.82	1.95	1.80	2.45	2.00	[illegible]
11	1.60	1.98	.....	2.11	3.08	3.29	2.82	1.95	1.80	2.80	2.00	[illegible]
12	.....	.....	2.80	2.17	3.26	3.24	2.80	1.95	1.80	2.70	2.00	[illegible]
13	1.90	.....	2.72	2.86	3.39	3.26	2.80	1.95	1.80	3.30	2.00	[illegible]
14	1.90	.....	2.66	3.20	3.34	3.25	2.80	1.95	1.75	3.05	2.00	[illegible]
15	1.90	.....	2.60	3.12	3.30	3.18	2.80	1.95	1.75	2.60	2.00	[illegible]
16	1.90	.....	2.20	2.81	3.30	3.16	2.70	1.95	1.75	2.40	2.00	[illegible]
17	1.90	2.80	2.22	2.52	3.30	3.16	2.65	1.85	1.75	2.20	2.00	[illegible]
18	1.90	2.70	2.58	2.52	3.26	3.10	2.55	1.92	1.75	2.15	2.00	[illegible]
19	1.90	2.40	2.60	2.58	3.18	3.05	2.34	2.00	1.75	2.15	2.00	[illegible]
20	1.90	2.06	2.70	2.60	3.10	2.90	2.25	1.98	1.75	2.15	2.00	[illegible]
21	1.90	1.94	2.84	2.60	3.10	2.85	2.25	1.92	1.75	2.15	2.00	[illegible]
22	1.90	2.48	2.84	2.65	3.25	2.90	2.25	1.90	1.75	2.15	2.00	[illegible]
23	1.90	2.95	2.84	2.51	3.32	3.00	2.28	1.90	1.75	2.20	2.00	[illegible]
24	1.89	.....	.....	2.48	3.38	3.10	2.30	1.90	1.75	2.20	2.00	[illegible]
25	1.70	.....	2.94	2.45	3.42	3.05	2.50	1.85	1.75	2.20	2.00	[illegible]
26	1.70	.....	2.94	2.42	3.42	3.00	2.50	1.85	1.75	2.20	2.00	[illegible]
27	1.70	.....	2.48	2.28	3.30	3.00	2.50	1.85	1.75	2.20	2.00	[illegible]
28	1.69	2.80	2.55	2.14	3.30	3.00	2.50	1.85	1.80	2.20	2.00	[illegible]
29	1.69	2.75	2.70	2.14	3.29	3.00	2.50	1.80	1.80	2.15	2.00	[illegible]
30	1.69	.....	2.49	2.12	3.30	3.05	2.38	1.80	1.80	2.15	2.00	[illegible]
31	1.69	.....	2.14	.....	3.20	.....	2.38	1.80	.....	2.15	.....	[illegible]

Rating table for Independence Creek below Independence Lake, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	0.5	1.85	2.8	2.40	17	3.00	87
1.55	.7	1.90	3.4	2.50	23	3.10	107
1.60	.9	1.95	4.0	2.60	30	3.20	127
1.65	1.2	2.00	4.7	2.70	40	3.30	148
1.70	1.5	2.10	6.7	2.80	53	3.40	170
1.75	1.9	2.20	9.5	2.90	69	3.50	192
1.80	2.3	2.30	13				

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is well defined between gage heights 2.00 feet and 3.25 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Independence Creek below Independence Lake, Cal., for 1904.

[Drainage area, 8.5 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	3.4	0.6	2.03	125	0.239	0.276
February	78	1.4	26.1	1,501	3.07	3.31
March	76	7.7	35.4	2,177	4.16	4.80
April	127	6.7	24.3	1,446	2.86	3.19
May	174	7.2	110	6,764	12.94	14.92
June	157	61	112	6,664	13.18	14.71
July	107	11	42.5	2,613	5.00	5.76
August	11.0	2.3	5.63	346	.662	.763
September	2.3	1.9	2.11	125	.247	.276
October	148	2.3	18.5	1,138	2.18	2.51
November	30	4.7	6.05	360	.712	.794
December	127	3.4	29.0	1,783	3.41	3.93
The year	174	0.6	34.5	25,040	4.05	55.12

NOTE.--Gage heights interpolated for missing days.

PROSSER CREEK NEAR HOBART MILLS, CAL.

This station was established June 27, 1903, by George B. Lorenz. It is located about 150 feet below the wagon bridge and the road house on the Boca and Truckee highway, 4 miles from Truckee and 3 miles from Hobart Mills. Alder Creek joins Prosser Creek about 200 feet above the station. The nearest dam is located at the ice pond, about 2 miles below the station. The original gage consisted of a 2 by 4 inch vertical timber, graduated to feet and tenths and reading from zero to 4 feet. It was located on the left or north bank, 50 feet upstream from the cable. The old gage rod was washed out by a flood on February 24, 1904. A new gage was established at the same point, with its zero 9.58 feet below bench mark. The zero of the old gage was 9.57 feet below the bench mark. The bench mark is on the northeast pier of the steel wagon bridge, and is the top of the steel casing of the concrete pier above the arrow mark. Readings are taken twice each day by Robert Dorian. Discharge measurements are made from a §-inch steel cable and car stretched across the river about 5 feet above high-water level. A tag wire is stretched just above the cable. The channel is straight for 150 feet above and 200 feet below the cable. The creek makes a bend at the highway bridge. Both banks are high and not subject to overflow. The right bank is wooded; the left is cleared, except for a few willows. The bed is composed of coarse gravel and is free from vegetation. The water flows in one channel at all stages.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Prosser Creek near Hobart Mills, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	W. A. Wolf	60	74	2.93	3.00	
May 13	do	55	108	5.46	3.95	
May 26	do	65	99	4.18	3.50	
June 11	do	65	93	3.72	3.35	
June 16	A. E. Chandler	60	90	3.70	3.20	
July 1	W. A. Wolf	60	66	3.05	2.92	
July 13	do	59	59	2.21	2.70	
July 23	do	59	55	2.20	2.65	
August 13	do	54	36	1.10	2.30	
August 29	do	54	28	.93	2.15	
November 16	do	15	17	1.78	2.20	

Mean daily gage height, in feet, of Prosser Creek near Hobart Mills, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.35	2.50	3.05	3.15	3.10	3.45	2.95	2.45	2.15	2.45
2	2.30	2.60	3.20	3.25	3.05	3.45	2.95	2.55	2.15	2.35
3	2.55	2.65	3.25	3.30	3.05	3.50	2.95	2.45	2.15	2.35
4	2.60	2.55	3.15	3.20	3.20	3.45	2.85	2.45	2.15	2.25
5	2.65	2.75	3.05	3.10	3.20	3.40	2.85	2.45	2.15	2.20
6	2.70	2.90	3.15	3.20	3.25	3.45	2.85	2.45	2.15	2.35
7	2.75	2.80	3.45	3.30	3.35	3.45	2.85	2.45	2.15	2.45
8	2.70	2.90	3.65	3.50	3.55	3.35	2.85	2.45	2.15	2.40
9	2.65	2.80	3.45	3.60	3.65	3.25	2.75	2.40	2.15	2.45
10	2.65	2.85	3.65	3.70	3.80	3.25	2.75	2.35	2.15	2.60
11	2.55	2.95	3.45	3.75	3.80	3.25	2.75	2.35	2.15	3.40
12	2.50	3.00	3.15	3.85	3.80	3.25	2.75	2.35	2.15	3.00
13	2.70	3.25	3.10	4.05	3.80	3.20	2.75	2.35	2.10	2.80
14	2.55	3.55	3.05	4.10	3.75	3.25	2.70	2.35	2.10	2.70
15	2.55	4.05	3.00	4.00	3.80	3.25	2.65	2.35	2.10	3.00
16	2.45	4.25	3.00	3.85	3.75	3.25	2.65	2.35	2.15	.....
17	2.55	4.20	3.15	3.70	3.75	3.15	2.60	2.35	2.15	.....
18	2.55	3.85	3.35	3.65	3.75	3.15	2.60	2.25	2.10	.....
19	2.65	3.15	4.25	3.55	3.70	3.05	2.60	2.25	2.10	.....
20	2.70	2.55	4.00	3.55	3.70	3.05	2.60	2.25	2.10	.....
21	2.75	2.90	3.50	3.35	3.70	3.05	2.60	2.25	2.10	.....
22	2.55	3.70	3.25	3.30	3.65	3.05	2.60	2.15	2.20	.....
23	2.60	4.50	3.20	3.10	3.65	3.05	2.60	2.15	2.25	.....
24	2.55	4.70	3.05	3.10	3.65	3.05	2.55	2.20	2.25	.....
25	2.45	4.60	3.00	3.10	3.60	3.05	2.55	2.15	2.20	.....
26	2.55	4.15	3.00	3.05	3.55	3.00	2.55	2.15	2.20	.....
27	2.65	3.95	3.05	3.05	3.55	2.95	2.55	2.15	2.15	.....
28	2.65	3.15	3.30	3.05	3.55	3.00	2.50	2.20	2.15	.....
29	2.55	2.50	3.55	3.05	3.55	3.05	2.50	2.20	2.15	.....
30	2.60	.....	3.25	3.00	3.45	3.05	2.50	2.15	2.20	.....
31	2.70	.....	3.15	.....	3.45	.....	2.45	2.15	.....	.....

NOTE.—Gage heights for entire year refer to new datum.

Rating table for Prosser Creek near Hobart Mills, Cal., from June 27, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.10	23	2.90	190	3.70	490	4.50	836
2.20	30	3.00	221	3.80	532	4.60	880
2.30	42	3.10	256	3.90	574	4.70	924
2.40	59	3.20	293	4.00	616	4.80	968
2.50	80	3.30	331	4.10	660	4.90	1,012
2.60	103	3.40	370	4.20	704	5.00	1,056
2.70	130	3.50	410	4.30	748	5.10	1,100
2.80	160	3.60	450	4.40	792		

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.80 feet and 3.50 feet. The table has been extended beyond these limits. Above gage height 4.00 feet the rating curve is a tangent, the difference being 44 per tenth.

Estimated monthly discharge of Prosser Creek near Hobart Mills, Cal., for 1903 and 1904.

[Drainage area, 48 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
July	69	18	31.3	1,925	0.652	0.75
August	20	12	16.8	1,033	.350	.40
September	12	10	10.5	625	.219	.24
October, 10 days	184	17	12.0	238	.250	.09
November, 19 days	370	30	16.3	6,142	3.40	2.40
December	130	42	75.0	4,612	1.56	1.8
The period				14,580		
1904.						
January	145	42	102	6,272	2.12	2.4
February	924	80	363	20,880	7.56	8.5
March	726	221	329	20,230	6.85	7.9
April	660	221	380	22,610	7.75	8.6
May	532	238	433	26,620	9.02	10.4
June	410	205	296	17,610	6.17	6.8
July	205	69	128	7,870	2.67	3.0
August	97	26	45.8	2,816	.954	1.1
September	35	23	6.4	1,571	.550	.6
October 1–15	370	30	112	3,332	2.33	1.3
The period				129,800		

DONNER CREEK NEAR TRUCKEE, CAL.

This station was established October 23, 1902, by E. C. Murphy. It is located about 150 feet below the dam of the Donner Creek L. Company and 1½ miles west of Truckee, Cal. The gage is a 4 by inch vertical timber located on the left bank. It is read twice ea day by F. R. Williams. Discharge measurements are made by mea of a cable and car 50 feet downstream from the gage. The chann is straight for 150 feet above and below the cable. Both banks ar high and will not overflow. The bed of the stream is composed gravel, permanent and free from vegetation. There is but one cha nel at all stages and the current is swift. The bench mark consist four nails driven into the root of a pine tree 12 inches in diameter a 35 feet north of the gage. Its elevation is 6.30 feet above the zero the gage.

The observations at this station during 1904 have been made und the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Donner Creek near Truckee, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 13	W. A. Wolf	40	114	4.90	4.60	559
May 26	do	40	108	4.97	4.55	536
June 11	do	40	77	4.35	3.80	334
June 17	A. E. Chandler	36	64	4.12	3.53	264
July 13	W. A. Wolf	18	20	2.31	2.25	46
July 23	do	18	19	2.29	2.20	43
August 13	do	14	11	1.04	1.55	11
August 29	do	8	4	1.05	1.35	4
November 16	do	14	11	1.07	1.60	12

Mean daily gage height, in feet, of Donner Creek near Truckee, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.60	2.00	3.30	3.65	3.35	4.20	3.15	1.80	1.35	2.25	1.90	1.70
2	1.60	2.00	3.85	3.60	3.30	4.40	3.05	1.70	1.35	2.00	1.90	1.70
3	1.80	2.00	4.30	3.60	3.35	4.35	2.85	1.70	1.30	1.85	1.90	1.70
4	2.05	2.00	4.80	3.50	3.40	4.35	2.75	1.70	1.30	1.80	1.90	1.70
5	1.85	1.90	4.35	3.50	3.55	4.25	2.70	1.70	1.30	1.80	1.60	1.40
6	2.00	1.90	4.10	3.50	3.75	4.30	2.70	1.70	1.30	1.85	1.35	1.40
7	2.00	1.90	4.20	3.50	3.95	4.30	2.70	1.70	1.30	2.05	1.40	1.40
8	2.00	2.00	4.40	3.55	4.15	4.25	2.55	1.60	1.30	2.05	1.60	1.40
9	2.00	2.00	4.05	3.60	4.30	4.15	2.45	1.60	1.30	2.05	1.80	1.45
10	2.00	2.00	4.00	3.60	4.40	3.90	2.40	1.55	1.30	2.60	1.80	1.50
11	2.00	2.00	3.85	3.80	4.35	3.90	2.45	1.55	1.30	3.25	1.80	1.40
12	2.00	2.00	3.75	4.00	4.50	3.75	2.30	1.55	1.30	2.85	1.80	1.40
13	2.00	2.00	3.65	4.25	4.60	3.70	2.20	1.50	1.55	2.60	1.80	1.40
14	2.00	2.00	3.60	4.25	4.65	3.70	2.10	1.50	2.60	2.55	1.80	1.40
15	2.00	2.15	3.50	4.25	4.65	3.70	2.10	1.45	2.55	2.50	1.80	1.40
16	2.05	2.80	3.50	4.05	4.75	3.60	1.70	1.45	2.50	2.45	1.60	1.40
17	2.00	2.75	3.45	3.95	4.75	3.50	1.60	1.45	2.40	2.40	1.60	1.40
18	2.00	2.50	4.10	4.00	4.55	3.50	2.15	1.50	2.30	2.30	1.45	1.40
19	2.50	2.50	4.45	4.00	4.35	3.50	2.25	1.50	2.25	2.30	1.25	1.40
20	2.50	2.40	4.05	3.90	4.30	3.55	2.20	1.45	2.20	2.30	1.20	1.40
21	2.00	2.55	4.05	3.80	4.65	3.55	2.10	1.40	2.15	2.20	1.20	1.40
22	2.00	4.30	4.60	3.65	5.10	3.60	2.10	1.40	2.10	2.20	1.20	1.40
23	2.00	4.90	4.45	3.60	5.10	3.50	2.10	1.40	2.10	2.20	1.20	1.40
24	2.00	5.05	4.20	3.50	4.70	3.35	2.10	1.40	2.30	2.10	1.20	1.40
25	2.00	3.95	4.05	3.50	4.75	3.30	2.10	1.45	2.30	2.10	1.20	1.70
26	2.00	3.70	3.90	3.45	4.55	3.30	2.10	1.45	2.30	2.00	1.65	1.64
27	2.00	3.60	3.90	3.40	4.50	3.30	2.00	1.45	2.35	2.00	1.70	1.40
28	2.00	3.50	4.20	3.40	4.60	3.30	1.95	1.40	2.05	2.00	1.70	1.40
29	2.00	3.40	4.05	3.40	4.55	3.30	1.90	1.40	2.00	2.00	1.70	1.30
30	2.00	.....	3.90	3.40	4.50	3.20	1.90	1.40	2.00	2.00	1.70	1.80
31	2.00	.....	3.80	.....	4.35	.....	1.90	1.35	.....	1.95	.....	2.35

NOTE.—The creek does not freeze over owing to the swift current.

Rating table for Donner Creek near Truckee, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	5.5	1.95	25	3.00	156	4.10	411
1.45	6.5	2.00	28	3.10	176	4.20	438
1.50	8	2.10	35	3.20	196	4.30	466
1.55	9.5	2.20	43	3.30	216	4.40	494
1.60	11	2.30	52	3.40	238	4.50	523
1.65	12.5	2.40	63	3.50	260	4.60	553
1.70	14	2.50	76	3.60	284	4.70	583
1.75	16	2.60	90	3.70	308	4.80	613
1.80	18	2.70	105	3.80	333	4.90	645
1.85	20	2.80	121	3.90	359	5.00	677
1.90	22	2.90	138	4.00	385	5.10	709

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904. It is well defined between gage heights 1.35 feet and 4.60 feet. The table has been extended above 4.60 feet.

Estimated monthly discharge of Donner Creek near Truckee, Cal., for 1904.

[Drainage area, 30 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	76	11	29.6	1,820	0.987	1.1
February	693	22	145	8,341	4.83	5.4
March	613	216	391	24,040	13.03	15.0
April	452	238	312	18,560	10.40	11.6
May	709	216	482	29,640	16.07	18.5
June	494	196	326	19,400	10.87	12.1
July	186	11	59.4	3,652	1.98	2.28
August	18	4.5	11.4	701	.380	.44
September	90	3.5	30.6	1,821	1.02	1.14
October	206	18	50.6	3,111	1.69	1.95
November	22	2.5	12.0	714	.400	.45
December	57	3.5	9.2	566	.307	.35
The year	709	2.5	155	112,400	5.16	70.04

WALKER RIVER (WEST FORK) NEAR COLEVILLE, CAL.

This station was established October 5, 1902, by E. C. Murphy. The gage is a 4 by 4 inch vertical timber on the left bank, about one-half mile above the cable and 300 feet from the observer's house. It is read once each day by J. S. Trumble. Discharge measurements are made by means of a cable and car near the mouth of the canyon about 1 mile east of the point where the main road from Topaz to Bridgeport crosses Lost Canyon Creek. The cable is located about 600 feet from the road. The initial point for soundings is the zero on the tagged wire. The channel is straight for 150 feet above and below the station. The current is swift. The right bank is low and rocky and is liable to overflow; the left bank is high and rocky and will not overflow. The bed of the stream is rocky and uneven. There is but one channel at all stages. The bench mark is a spike driven into the tree to which the gage is fastened. Its elevation is 6.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Walker River (West Fork) near Coleville, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec. feet.*
March 23	L. A. Wolley	.....	107	1.52	1.80	163
May 4	R. A. Craig	42	102	3.38	2.32	345
July 5	J. T. Shaw	54	172	5.94	3.82	1,022
July 13	....do	52	153	4.61	3.29	705
July 20	....do	53	177	4.78	3.38	847
July 27	....do	52	160	4.42	3.18	707
August 3	....do	51	138	3.81	2.79	526
August 10	....do	51	133	3.45	2.62	459
August 17	....do	.....	137	3.50	2.62	480
August 24	....do	.....	112	2.38	2.21	267
September 8	....do	.....	105	1.38	1.65	145
October 17	....do	.....	120	1.98	2.05	237

Mean daily gage height, in feet, of Walker River (West Fork) near Coleville, Cal., for 190

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	De
1	1.10	1.00	1.70	2.00	2.00	3.70	3.70	2.70	1.90	2.80	1.80	1.
2	1.10	1.00	1.70	2.00	2.10	3.40	3.70	2.50	1.80	2.80	1.70	
3	1.10	1.00	1.70	2.00	2.20	3.70	3.50	2.50	1.80	2.80	1.70	1.
4	1.10	1.00	1.70	1.90	2.20	4.00	3.50	2.50	1.80	2.80	1.70	1.
5	1.10	1.00	1.70	1.80	2.30	4.00	3.50	2.60	1.80	2.80	1.70	
6	1.10	1.00	1.70	1.90	2.50	4.30	3.50	2.70	1.80	2.70	1.70	1.
7	1.10	1.00	1.80	2.00	3.00	4.20	3.60	2.60	1.80	2.80	1.60	1.
8	1.10	1.00	2.00	2.60	3.30	4.00	3.50	2.50	1.70	2.70	1.60	1.
9	1.10	1.00	2.00	2.60	3.40	3.90	3.60	2.50	1.70	1.60	1.60	1.
10	1.10	1.00	1.80	2.70	3.50	3.80	3.70	2.50	1.70	2.00	1.60	1.
11	1.10	1.10	1.90	2.80	3.50	3.90	3.70	2.50	1.70	2.60	1.60	1.
12	1.10	1.20	1.80	3.10	3.50	4.10	3.70	2.40	1.60	2.30	1.60	1.
13	1.00	1.20	1.90	3.10	3.90	4.10	3.40	2.50	1.50	2.50	1.50	1.
14	1.00	1.20	1.70	3.00	3.60	4.00	3.10	2.60	1.70	2.30	1.50	1.
15	1.00	1.30	1.80	3.00	3.70	4.20	3.10	2.60	1.80	2.20	1.50	1.
16	1.00	1.70	1.80	2.70	3.70	4.10	3.10	2.60	1.80	2.10	1.54	1.
17	1.00	1.30	1.70	2.60	3.60	4.00	3.10	2.40	1.80	2.00	1.50	1.
18	1.00	1.30	1.80	2.70	3.60	4.00	3.10	2.20	1.80	2.00	1.50	1.
19	1.00	1.30	2.00	2.70	3.90	4.10	3.10	2.20	1.70	2.00	1.50	1.
20	1.00	1.30	2.10	2.60	3.70	4.10	3.10	2.20	1.70	2.00	1.50	1.
21	1.00	1.50	2.10	2.50	3.60	4.10	3.30	2.10	1.70	2.00	1.50	1.
22	1.00	2.00	1.90	2.50	3.70	4.00	3.50	2.00	1.60	2.00	1.50	1.
23	1.00	2.70	1.80	2.50	4.00	3.90	3.40	2.00	1.70	1.90	1.50	1.
24	1.00	2.70	1.70	2.60	4.40	3.80	3.40	2.10	1.80	1.90	1.50	1.
25	1.00	2.40	1.80	2.70	4.90	3.70	3.30	2.20	2.00	1.90	1.50	1.
26	1.00	2.00	1.80	2.60	3.80	3.70	3.20	2.10	1.90	1.90	1.50	1.
27	1.00	1.80	1.90	2.20	3.70	3.70	3.20	2.10	1.90	1.80	1.50	1.
28	1.00	1.80	2.00	2.20	3.80	3.80	3.00	2.10	1.90	1.80	1.50	1.
29	1.00	1.80	2.30	2.10	3.90	3.80	2.90	2.10	2.00	1.80	1.50	1.
30	1.00	.....	2.10	2.00	4.00	3.70	2.70	2.00	2.40	1.80	1.50	1.
31	1.00	.....	2.00	.....	4.00	.....	2.60	1.90	.....	1.80	.....	1.

Rating table for Walker River (West Fork) near Coleville, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	60	2.00	220	3.00	605	4.00	1,240
1.10	67	2.10	248	3.10	655	4.10	1,320
1.20	75	2.20	278	3.20	708	4.20	1,405
1.30	85	2.30	311	3.30	764	4.30	1,495
1.40	98	2.40	347	3.40	823	4.40	1,585
1.50	113	2.50	385	3.50	885	4.50	1,680
1.60	130	2.60	425	3.60	950	4.60	1,780
1.70	149	2.70	467	3.70	1,015	4.70	1,885
1.80	170	2.80	511	3.80	1,085	4.80	1,990
1.90	194	2.90	557	3.90	1,160	4.90	2,100

The above table is applicable only for open-channel conditions. It is based up 13 discharge measurements made during 1903 and 1904. It is well defined betwe gage heights 1.00 foot and 3.70 feet. The table has been extended beyond these lim

Estimated monthly discharge of Walker River (West Fork) near Coleville, Cal., for 1904.

[Drainage area, 306 square miles.]

Month.	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
January	67	60	62.7	3,855	0.205	0.236
February	467	60	131	7,535	.428	.461
March	311	149	187	11,500	.611	.704
April	655	170	384	22,850	1.25	1.40
May	2,100	220	919	56,510	3.00	3.46
June	1,495	823	1,188	70,690	3.88	4.33
July	1,015	425	785	48,270	2.57	2.96
August	467	194	332	20,410	1.08	1.24
September	347	113	172	10,240	.56	.627
October	511	130	299	18,380	.977	1.13
November	170	113	125	7,438	.408	.455
December	130	67	85.7	5,269	.280	.323
The year	2,100	60	389	282,900	1.27	17.33

WALKER RIVER (EAST FORK) NEAR YERINGTON, NEV.

This station was established October 6, 1902, by E. C. Murphy. It is located at Ross ranch, about 10 miles southeast of Yerington, Nev. The station is just above the point where the road crosses the river. The gage is a vertical 4 by 4 inch timber fastened to the right bank just below the cable. It is read once each day by I. A. Strosnider, the ranch owner. Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire. The channel is straight for 200 feet above and for 100 feet below the station. At low water the sand bar in the middle of the stream divides the channel into two parts. Both banks are low and are liable to overflow. The bed of the stream is composed of sand and clay and is liable to shift. The current has a moderate velocity. The bench mark consists of three nails and a spike in a stump 6 inches in diameter and 15 feet east of the gage. Its elevation is 5.85 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Walker River (East Fork) near Yerington, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 5	R. A. Craig	42	32	2.00	1.52	64
May 10	do	39	34	2.12	1.65	72
July 7	J. T. Shaw	75	163	2.94	3.31	479
July 12	do	75	153	2.85	3.02	436
July 21	do	76	134	2.90	2.98	388
July 26	do	76	148	3.09	3.25	458
August 4	do	76	140	2.94	3.08	412
August 9	do	76	130	2.72	2.90	353
August 18	do	.....	144	2.94	3.08	423
August 23	do	.....	108	2.77	2.60	298
September 12	do	.....	53	2.22	1.95	118
October 23	do	.....	97	2.64	2.52	257

Mean daily gage height, in feet, of Walker River (East Fork) near Yerington, Nev., for 19

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	De
1	1.60	1.50	2.50	2.20	1.60	3.00	3.60	3.10	2.30	[a]2.85	2.70	2.
2	1.60	1.50	2.50	2.15	1.50	3.00	3.50	3.10	2.20	2.80	2.70	2.
3	1.60	1.60	2.50	2.10	1.50	3.05	3.50	3.00	2.20	2.80	2.70	2.
4	1.50	1.70	2.50	2.00	1.50	3.05	3.50	3.00	2.20	2.80	2.70	2.
5	1.50	1.70	2.40	1.90	1.50	3.20	3.40	3.00	2.20	2.80	2.70	2.
6	1.50	1.70	2.30	1.90	1.50	3.30	3.40	3.00	2.20	2.70	2.70	2.
7	1.50	1.70	2.30	1.90	1.60	3.40	3.40	2.90	2.10	2.70	2.60	2
8	1.50	1.70	2.30	2.00	1.60	3.50	3.30	2.90	2.10	2.70	2.60	2
9	1.50	1.60	2.30	2.05	1.70	3.55	3.30	2.90	2.10	2.70	2.60	2.
10	1.60	1.60	2.30	2.10	1.70	3.60	3.20	2.90	2.10	2.70	2.60	2
11	1.75	1.60	2.30	2.10	1.70	3.60	3.20	2.80	2.00	2.70	2.50	2.
12	1.70	1.65	2.30	2.20	1.80	3.60	3.10	2.80	2.00	2.70	2.50	2.
13	1.60	1.75	2.30	2.30	1.90	3.60	3.00	2.80	2.00	2.70	2.50	2.
14	1.60	1.90	2.30	2.30	2.00	3.60	2.90	2.85	2.00	2.60	2.50	2.
15	1.60	2.05	2.30	2.25	2.05	3.70	2.90	2.90	2.00	2.60	2.40	2.
16	1.60	2.45	2.45	2.20	2.35	3.70	2.80	2.90	2.00	2.60	2.40	2.
17	1.65	2.80	2.40	2.20	2.40	3.70	2.90	3.75	2.00	2.60	2.40	2.
18	1.65	2.65	2.40	2.15	2.50	3.70	2.90	3.20	2.00	2.60	2.40	2.
19	1.70	2.25	2.40	2.10	2.60	3.80	2.90	3.10	2.00	2.60	2.30	2.
20	1.70	2.00	2.50	2.05	2.60	3.80	2.90	3.00	2.00	2.60	2.30	2.
21	1.60	2.00	2.50	2.00	2.70	3.80	2.90	2.90	2.00	2.65	2.30	2.
22	1.50	2.05	2.40	2.00	2.70	3.90	3.90	2.75	2.00	2.70	2.30	2.
23	1.50	2.25	2.40	1.90	2.80	3.90	3.50	2.65	2.00	2.70	2.30	2.
24	1.50	2.50	2.40	1.90	2.85	3.80	3.20	2.60	2.00	2.70	2.30	2.
25	1.50	3.05	2.30	1.80	2.90	3.80	3.10	3.15	2.30	2.70	2.30	2
26	1.50	3.00	2.30	1.80	3.30	3.70	3.10	2.90	2.95	2.80	2.30	2.
27	1.50	2.75	2.30	1.80	3.20	3.70	3.20	2.40	3.00	2.80	2.30	2.
28	1.50	2.55	2.50	1.80	3.10	3.60	3.20	2.30	3.00	2.80	2.30	2.
29	1.50	2.50	2.60	1.70	3.00	3.65	3.20	2.30	2.90	2.80	2.30	2
30	1.50	.....	2.40	1.70	2.95	3.60	3.10	2.30	2.90	2.80	2.30	2.
31	1.50	.....	2.40	.....	2.90	.....	3.10	2.30	.....	2.80	.....	2.

[a] Interpolated.

Rating table for Walker River (East Fork) near Yerington, Nev., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	60	2.20	172	2.90	358	3.50	560
1.60	73	2.30	193	3.00	390	3.60	594
1.70	87	2.40	216	3.10	424	3.70	628
1.80	102	2.50	241	3.20	458	3.80	662
1.90	118	2.60	268	3.30	492	3.90	696
2.00	135	2.70	297	3.40	526	4.00	730
2.10	153	2.80	327				

The above table is applicable only for open-channel conditions. It is based upon 20 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.50 feet and 3.30 feet. The table has been extended above gage height 3.30 feet. Above gage height 3.00 feet the rating curve is a tangent, the difference being 34 per tenth.

Estimated monthly discharge of Walker River (East Fork) near Yerington, Nev., for 1904.

[Drainage area, 1,103 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	95	60	68.8	4,230	0.062	0.072
February	407	60	164	9,433	.149	.161
March	268	193	214	13,160	.194	.224
April	193	87	140	8,331	.127	.142
May	492	60	213	13,100	.193	.222
June	696	390	582	34,630	.528	.589
July	696	327	458	28,160	.415	.478
August	645	193	349	21,460	.316	.364
September	390	135	187	11,130	.170	.190
October	343	268	301	18,510	.273	.315
November	297	172	226	13,450	.205	.229
December	172	135	147	9,039	.133	.153
The year	696	60	254	184,600	.230	3.14

WALKER RIVER NEAR WABUSKA, NEV.

This station was established July 22, 1902, by L. H. Taylor. It was equipped December 12, 1902, by E. C. Murphy. It is located about 300 feet above the Carson and Colorado Railroad bridge near the section house at Clever station. It is about 2½ miles east of Wabuska. The original gage was washed out December 30, 1903. A new gage, consisting of a 1 by 4 inch board fastened to a vertical 4 by 4 inch timber, was installed January 17, 1904. It is on the left bank 15 feet below the point at which the old gage was located and 150 feet south of the section house. The datum is the same as that of the original gage. The gage is read twice each day by Charles Nelson. Discharge measurements are made by means of a cable and car 35 feet below the gage. The initial point for soundings is the zero on the tagged wire. The channel is straight for 150 feet above the station and slightly curved for the same distance below. Both banks are high and not liable to overflow. The bed of the stream is sandy and shifting. There is but one channel at all stages. The current has a moderate velocity and the discharge is small from August to October. The bench mark consists of four nails driven into the northwest corner of the pump platform 35 feet east of the gage. Its elevation is 6.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Walker River near Wabuska, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 25	L. A. Wooley	71	110	2.16	2.15	[illegible]
April 29	R. A. Craig	46	60	2.17	1.76	[illegible]
May 6	do	58	45	1.69	1.58	[illegible]
May 9	do	65	86	2.41	2.10	[illegible]
July 8	J. T. Shaw	74	303	3.22	3.72	[illegible]
July 11	do	74	299	3.19	3.58	[illegible]
July 22	do	68	170	2.96	2.60	[illegible]
July 25	do	75	260	3.33	3.40	[illegible]
August 5	do	74	165	2.93	2.45	[illegible]
August 8	do	65	150	2.74	2.30	[illegible]
August 19	do		144	2.59	2.30	[illegible]
August 22	do		117	2.28	1.94	[illegible]
September 13	do		28	1.61	1.03	[illegible]
October 24	do		164	2.67	2.41	[illegible]

Mean daily gage height, in feet, of Walker River near Wabuska, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.30	2.60	2.25	1.70	4.10	4.00	2.43	1.72	2.00	2.48	2.00
2	.....	2.15	2.35	2.20	1.65	3.95	4.00	2.48	1.68	2.10	2.45	2.00
3	2.00	2.00	2.35	2.18	1.65	3.90	3.92	2.52	1.60	2.30	2.40	2.00
4	2.05	2.00	2.40	2.12	1.60	3.95	3.85	2.55	1.52	2.30	2.40	2.00
5	2.50	1.90	2.30	2.10	1.60	4.20	3.72	2.42	1.50	2.50	2.38	1.95
6	2.95	1.85	2.30	2.02	1.60	4.20	3.62	2.40	1.45	2.50	2.30	1.95
7	3.25	1.80	2.25	2.05	1.62	4.35	3.70	2.40	1.40	2.50	2.30	1.90
8	3.05	1.75	2.15	2.10	1.75	4.45	3.72	2.35	1.40	2.45	2.30	1.90
9	2.85	1.80	2.20	2.10	2.02	4.60	3.75	2.30	1.35	2.40	2.25	1.90
10	2.70	1.75	2.20	2.10	2.25	4.45	3.70	2.22	1.30	2.35	2.25	1.90
11	2.60	1.80	2.20	2.18	2.40	4.30	3.62	2.18	1.30	2.45	2.25	1.85
12	2.50	1.85	2.20	2.25	2.55	4.35	3.45	2.12	1.20	2.65	2.20	1.85
13	2.40	1.80	2.10	2.38	2.75	4.35	3.40	2.02	1.05	2.90	2.17	1.85
14	2.50	1.75	2.12	2.35	2.92	4.32	3.20	2.00	1.00	2.95	2.12	1.80
15	2.50	1.72	2.20	2.35	3.10	4.32	3.05	2.00	1.00	2.90	2.10	1.80
16	2.40	1.90	2.28	2.50	3.20	4.35	2.90	2.02	1.00	2.80	2.02	1.82
17	3.20	2.05	2.30	2.62	3.28	4.42	2.75	2.38	1.00	2.70	2.00	1.85
18	2.80	2.50	2.30	2.50	3.35	4.40	2.68	2.42	1.00	2.60	2.00	1.85
19	2.70	2.38	2.30	2.38	3.48	4.40	2.60	2.28	1.00	2.50	1.95	1.85
20	2.65	2.30	2.30	2.30	3.55	4.45	2.60	2.18	1.00	2.50	1.95	1.85
21	2.60	2.25	2.40	2.22	3.38	4.40	2.58	2.00	1.00	2.50	1.97	1.80
22	2.50	2.25	2.40	2.20	3.22	4.32	2.55	1.98	1.00	2.45	2.00	1.80
23	2.45	2.20	2.35	2.15	3.40	4.30	2.55	1.95	1.00	2.45	2.00	1.80
24	2.40	2.25	2.30	2.05	3.75	4.28	3.20	1.85	1.00	2.42	2.00	1.80
25	2.40	2.80	2.20	2.00	4.20	4.22	3.40	1.78	1.10	2.40	2.00	1.80
26	2.45	3.30	2.20	1.95	4.55	4.12	3.32	1.78	1.55	2.40	2.00	1.75
27	2.40	3.15	2.20	1.90	4.88	4.05	3.28	1.95	2.00	2.40	2.00	1.80
28	2.45	2.80	2.35	1.85	4.60	3.98	3.18	2.08	2.05	2.40	2.00	1.82
29	2.40	2.70	2.42	1.80	4.25	3.92	3.02	2.08	2.00	2.40	2.00	1.85
30	2.25	.....	2.55	1.75	4.00	3.98	2.98	1.95	1.95	2.45	2.00	1.80
31	2.25	.....	2.45	.....	4.05	.....	2.80	1.82	.....	2.50	.....	2.02

Rating table for Walker River near Wabuska, Nev., from January 1 to May 29, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	64	2.40	315	3.30	732	4.20	1,182
1.60	83	2.50	254	3.40	782	4.30	1,232
1.70	105	2.60	395	3.50	832	4.40	1,282
1.80	129	2.70	438	3.60	882	4.50	1,332
1.90	155	2.80	483	3.70	932	4.60	1,382
2.00	183	2.90	532	3.80	982	4.70	1,432
2.10	213	3.00	582	3.90	1,032	4.80	1,482
2.20	245	3.10	632	4.00	1,082	4.90	1,532
2.30	279	3.20	682	4.10	1,132		

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during the spring of 1904. It is well defined between gage heights 1.60 feet and 2.15 feet. The table has been extended beyond these limits, but is poorly defined. Above gage height 2.85 feet the rating curve is a tangent, the difference being 50 per tenth.

Rating table for Walker River near Wabuska, Nev., from May 30 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	40	2.00	285	3.00	678	3.90	1,081
1.10	55	2.10	321	3.10	720	4.00	1,127
1.20	73	2.20	359	3.20	763	4.10	1,173
1.30	93	2.30	397	3.30	807	4.20	1,219
1.40	115	2.40	435	3.40	851	4.30	1,265
1.50	139	2.50	475	3.50	897	4.40	1,311
1.60	164	2.60	515	3.60	943	4.50	1,357
1.70	191	2.70	555	3.70	989	4.60	1,403
1.80	220	2.80	595	3.80	1,035	4.70	1,449
1.90	251	2.90	636				

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during latter half of 1904. It is fairly well defined between gage heights 2.30 feet and 3.70 feet. The table has been extended beyond these limits, but is poorly defined. Above gage height 3.40 feet the rating curve is a tangent, the difference being 46 per tenth.

Estimated monthly discharge of Walker River near Wabuska, Nev., for 1904.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	707	108	369	22,690	0.152	0.175
February	732	110	255	14,670	.105	.113
March	395	213	280	17,220	.116	.134
April	403	117	237	14,100	.098	.109
May	1,522	83	629	38,680	.260	.300
June	1,403	1,081	1,240	73,790	.512	.571
July	1,127	495	797	49,010	.329	.379
August	495	214	346	21,280	.143	.165
September	303	40	114	6,783	.047	.052
October	657	285	471	28,960	.195	.225
November	467	268	338	20,110	.140	.156
December	292	205	242	14,880	.100	.115
The year	1,522	40	443	322,200	.183	2.49

CARSON RIVER (WEST FORK) NEAR WOODFORDS, CAL.

This station was established October 18, 1900, by L. H. Taylor. It is located about three-fourths mile above the post-office at Woodfords and 200 feet from the main road between Woodfords and Blue Lakes, Cal. The gage is a vertical board nailed to a cottonwood tree on the left bank. It is read once each day by Miss Bernice Merrill. Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is the zero of the tagged wire. The channel is straight for 100 feet above and below the cable, and there is but one channel at all stages. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rocky and uneven and is not liable to change. At high water the current velocity is too high for accurate measurement.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Carson River (West Fork) near Woodfords, Cal., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 3	R. A. Craig	22	66	3.08	3.75	203
July 3	J. T. Shaw	29	92	2.71	3.95	249
July 15	do	28	76	2.29	3.61	174
July 18	do	28	72	2.18	3.55	157
July 29	do	22	49	2.18	3.20	107
August 1	do	22	46	2.15	3.12	99
August 12	do		40	2.08	2.83	83
August 15	do		37	1.89	2.68	70
September 6	do		34	1.88	2.55	64
September 23	do		35	1.40	2.52	49
October 13	do	30	56	1.90	3.15	106

Mean daily gage height, in feet, of Carson River (West Fork) near Woodfords, Cal., for 190[illegible].

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.43	.....	3.82	3.60	3.71	4.84	3.82	3.09	2.55	2.88	2.68	[illegible]
2	2.43	.....	3.66	3.50	3.66	4.95	3.80	3.14	2.55	2.73	2.68	[illegible]
3	2.43	.....	3.60	3.55	4.12	4.95	3.77	3.09	2.55	2.73	2.68	[illegible]
4	2.38	.....	3.60	3.50	4.43	5.20	3.77	3.09	2.60	2.68	2.68	[illegible]
5	2.38	.....	3.66	3.45	4.90	5.20	3.82	2.99	2.55	2.78	2.63	[illegible]
6	2.38	.....	3.71	3.55	5.52	5.09	3.77	3.04	2.50	2.88	2.58	[illegible]
7	2.48	2.48	3.71	3.66	5.78	5.04	3.72	2.88	2.55	2.88	2.58	[illegible]
8	2.48	2.53	3.71	3.87	5.78	4.88	3.67	2.88	2.44	2.83	2.58	[illegible]
9	2.58	2.53	3.66	4.12	5.98	4.78	3.67	2.88	2.39	2.88	2.58	[illegible]
10	2.58	2.48	3.60	4.38	6.14	4.68	3.67	2.78	2.39	3.04	2.63	[illegible]
11	2.58	2.48	3.50	4.68	6.40	4.68	3.62	2.78	2.39	3.09	2.63	[illegible]
12	2.58	2.53	3.45	4.95	6.45	4.73	3.57	2.83	2.44	2.99	2.68	[illegible]
13	2.58	2.58	3.40	5.68	6.19	4.78	3.62	2.78	2.34	2.88	2.68	[illegible]
14	2.58	2.63	3.45	5.37	6.19	4.88	3.65	2.73	2.78	2.83	2.68	[illegible]
15	2.63	2.68	3.45	5.10	6.14	4.83	3.67	2.68	2.99	2.88	2.68	[illegible]
16	2.58	2.78	3.35	4.95	5.98	4.73	3.62	2.68	3.09	2.88	2.63	[illegible]
17	2.53	2.83	3.30	4.95	5.98	4.68	3.57	2.63	2.88	2.78	2.58	[illegible]
18	2.53	2.83	3.30	4.90	5.52	4.68	3.57	2.68	3.76	2.88	2.68	[illegible]
19	2.53	2.88	3.87	4.84	5.57	4.68	3.52	2.63	2.68	2.88	2.63	[illegible]
20	2.58	2.99	3.76	4.79	5.73	4.58	3.47	2.58	2.63	2.88	2.63	[illegible]
21	2.53	3.14	3.71	4.79	5.73	4.47	3.57	2.48	2.63	2.88	2.58	[illegible]
22	2.53	3.66	3.60	4.22	5.47	4.37	3.57	2.48	2.58	2.83	2.63	[illegible]
23	2.53	3.92	3.60	4.22	5.57	4.22	3.24	2.53	2.53	2.78	2.68	[illegible]
24	2.48	4.43	3.55	4.27	5.47	4.17	3.24	2.63	2.68	2.78	2.63	[illegible]
25	2.48	4.48	3.50	4.38	5.47	4.07	3.24	2.58	2.68	2.73	2.78	[illegible]
26	2.43	4.32	3.55	4.07	5.21	4.02	3.09	2.48	2.68	2.68	2.78	[illegible]
27	2.43	4.27	3.66	2.88	4.84	4.02	3.19	2.53	2.68	2.68	2.68	[illegible]
28	2.43	4.02	3.87	3.71	4.84	4.02	3.14	2.70	2.63	2.68	2.68	[illegible]
29	2.38	3.97	3.76	3.82	4.84	3.97	3.14	2.70	2.68	2.63	2.63	[illegible]
30	2.38	.....	3.71	3.76	4.79	4.07	3.09	2.65	2.73	2.63	2.63	[illegible]
31	.....	.....	3.66	.....	4.84	.....	3.09	2.60	.....	2.63	.....	[illegible]

Rating table for Carson River (West Fork) near Woodfords, Cal., from January [illegible], to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	36	3.30	128	4.40	304	5.50	657
2.30	42	3.40	140	4.50	327	5.60	697
2.40	48	3.50	154	4.60	352	5.70	737
2.50	54	3.60	168	4.70	379	5.80	779
2.60	61	3.70	182	4.80	408	5.90	823
2.70	69	3.80	197	4.90	439	6.00	869
2.80	77	3.90	213	5.00	472	6.10	916
2.90	86	4.00	229	5.10	507	6.20	964
3.00	96	4.10	246	5.20	543	6.30	1,012
3.10	106	4.20	264	5.30	580	6.40	1,060
3.20	116	4.30	283	5.40	618	6.50	1,110

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is poorly defined. The table has been extended above gage height 4.50 feet.

Estimated monthly discharge of Carson River (West Fork) near Woodfords, Cal., for 1904.

[Drainage area, 70 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1–30	63	47	53.8	3,201	0.769	0.858
February 7–29	322	53	134	6,113	1.91	1.63
March	208	128	169	10,390	2.41	2.78
April	729	84	305	18,150	4.36	4.86
May	1,085	176	651	40,030	9.30	10.72
June	543	224	368	21,900	5.26	5.87
July	200	105	158	9,715	2.26	2.61
August	110	53	74.4	4,575	1.06	1.22
September	191	44	67.1	3,993	.959	1.07
October	105	63	78.4	4,821	1.12	1.29
November	75	59	64.6	3,844	.923	1.03
December	121	47	64.5	3,966	.921	1.06
The period				130,700		

CARSON RIVER (EAST FORK) NEAR GARDNERVILLE, NEV.

The gaging station was established by L. H. Taylor on October 17, 1900, at the place where measurements were made in the years 1890, 1891, and 1892. The old gage was an inclined timber securely fastened to posts set in the right bank of the stream. The old bench mark was on a basalt rock in the edge of the stream, 20 feet from the gage and at an elevation of 6.30 feet above gage datum.

On August 2, 1901, a loose-rock dam was raised a short distance below the gaging station, which affected the velocity at the latter point. The dam was partly washed out by a freshet on December 4, 1901. A new gage was established on March 10, 1902, a short distance downstream from the original one, which had been destroyed. It consists of a vertical timber driven into the stream bed at the right bank and spiked to a cottonwood tree. On October 3, 1902, a new inclined gage was installed by E. C. Murphy at a point on the left bank of the river 600 feet above the cable. During 1904 gage heights were read on the vertical gage at the cable.

The gage is read twice each day by Miss Susie Rodenbah. Discharge measurements are made by means of a cable and car located at the vertical gage about 400 feet above the bridge. The initial point for soundings is the zero of the tagged wire on the right bank. The

channel is straight for 300 feet above and below the station. It is broad and shallow. There is but one channel at all stages, and the current is moderate. Both banks are high and are not liable to overflow. The bed of the stream is composed of gravel and is permanent. The bench mark for the gage at the cable is the top of a granite bowlder 20 feet south of the gage. Its elevation is 8.10 feet above the zero of the gage. The bench mark for the new inclined gage is the top of a bowlder 2 feet east of the gage. Its elevation is 9.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Carson River (East Fork) near Gardnerville, Nev., in 190

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis charg
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second*
March 12	L. A. Woolley	89	222	2.04	4.08	45
May 3	R. A. Craig	73	197	2.77	4.22	54
May 12	do	80	338	6.13	6.15	2.0
July 4	J. T. Shaw	91	296	3.45	5.01	1.0
July 14	do	90	233	2.63	4.50	61
July 19	do	90	245	2.84	4.59	69
July 28	do	89	219	2.18	4.30	47
August 2[a]	do	87	226	2.19	4.46	49
August 11[a]	do	85	195	1.43	4.03	28
August 16[a]	do		191	1.32	4.04	25
August 25[a]	do		210	.99	4.16	20
September 7[a]	do		143	.83	3.50	12
September 22[a]	do		194	.76	4.05	15
October 15	do		205	1.78	4.20	36

[a] Temporary dam in stream below station affects measurements.

Mean daily gage height, in feet, of Carson River (East Fork) near Gardnerville, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.40	2.80	4.50	4.22	4.28	6.20	4.28	4.34	3.10	4.35	3.65	2.55
2	2.40	2.90	4.65	4.20	4.24	6.24	4.18	4.74	3.00	4.45	3.60	2.55
3	2.40	2.98	4.75	4.25	4.24	6.35	4.32	4.74	2.98	4.28	3.60	2.55
4	2.45	3.00	4.75	4.35	4.22	6.42	5.04	4.65	3.30	4.26	3.60	2.00
5	2.50	2.90	4.40	4.35	4.62	6.48	4.97	5.09	3.50	4.22	3.58	2.00
6	2.50	2.90	4.15	4.42	5.10	5.42	4.88	4.88	3.60	4.16	3.52	2.00
7	2.50	2.90	4.20	4.48	5.30	5.52	4.94	4.60	3.75	4.07	3.35	2.00
8	2.48	3.00	4.35	4.52	5.48	5.52	4.97	4.44	3.85	4.00	3.30	2.00
9	2.48	3.15	4.70	4.56	5.62	5.48	4.70	4.60	3.94	4.15	3.27	2.00
10	2.80	3.25	4.60	4.58	5.85	5.25	4.65	4.55	3.98	4.23	3.22	2.00
11	2.80	3.35	4.62	5.08	6.10	4.95	4.72	4.35	4.00	4.35	3.12	2.10
12	2.78	3.45	4.62	5.40	6.38	4.90	4.62	4.00	4.00	4.71	3.10	2.10
13	2.75	3.80	4.50	5.65	6.60	4.42	4.58	3.85	4.12	4.58	3.05	2.05
14	2.80	3.85	4.05	5.62	6.95	3.98	4.55	3.88	4.25	4.46	3.05	2.12
15	2.78	3.85	4.12	5.48	6.75	3.58	4.48	3.94	4.60	4.37	2.95	2.12
16	2.75	5.80	4.18	5.38	6.55	3.38	4.42	3.97	4.60	4.32	2.95	2.10
17	2.70	5.20	4.40	5.32	6.45	3.29	4.48	4.22	4.58	4.31	2.85	2.10
18	2.68	4.82	4.75	5.25	6.25	3.08	4.52	4.21	4.63	4.30	2.80	2.10
19	2.65	4.68	5.00	5.20	6.18	4.50	4.58	4.24	4.62	4.28	2.80	2.00
20	2.62	4.55	4.95	5.12	5.90	5.05	4.68	4.19	4.62	4.28	2.78	2.00
21	2.62	4.85	4.80	4.90	6.90	5.58	4.75	4.10	4.61	4.27	2.75	2.00
22	2.60	4.95	4.68	4.65	7.05	5.65	4.85	4.00	4.60	4.26	2.75	2.00
23	2.60	5.40	4.38	4.45	7.12	5.38	4.88	3.90	4.62	4.24	2.72	2.00
24	2.70	7.30	4.32	4.50	7.02	5.05	4.65	3.92	4.64	4.20	2.70	2.05
25	2.65	4.95	4.10	4.52	6.70	4.40	4.48	3.83	4.60	4.10	2.70	2.10
26	2.65	4.80	4.05	4.48	6.40	4.18	4.40	3.78	4.51	3.95	2.70	2.20
27	2.68	5.05	4.22	4.42	6.36	4.22	4.31	3.52	4.42	3.85	2.70	2.25
28	2.68	4.30	4.68	4.37	6.50	4.29	4.28	3.41	4.34	3.75	2.80	2.30
29	2.70	4.40	4.80	4.45	6.35	4.28	4.22	3.37	4.25	3.68	2.75	2.28
30	2.70	.....	4.50	4.38	6.32	4.28	4.20	3.34	4.30	3.62	2.65	2.29
31	2.85	.....	4.28	.....	6.28	.....	4.14	3.31	.....	3.65	.....	2.34

NOTE.—Beginning August 1 the gage heights were affected by temporary dam below the station.

Rating table for Carson River (East Fork) near Gardnerville, Nev., from January 1 to July 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	8	3.40	114	4.80	833	6.20	2,130
2.10	9	3.50	134	4.90	915	6.30	2,230
2.20	11	3.60	158	5.00	1,000	6.40	2,330
2.30	14	3.70	186	5.10	1,085	6.50	2,430
2.40	18	3.80	218	5.20	1,175	6.60	2,540
2.50	23	3.90	254	5.30	1,265	6.70	2,650
2.60	29	4.00	295	5.40	1,355	6.80	2,760
2.70	36	4.10	342	5 50	1,450	6.90	2,870
2.80	43	4.20	397	5.60	1,545	7.00	2,980
2.90	51	4.30	459	5.70	1,640	7.20	3,200
3.00	60	4.40	527	5.80	1,735	7.40	3,420
3.10	71	4.50	600	5.90	1,830		
3.20	83	4.60	675	6.00	1,930		
3.30	97	4.70	753	6.10	2,030		

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during first part of 1904 and several low-water measurements of 1903. It is well defined between gage heights 3.00 feet and 5.00 feet. The table has been extended beyond these limits. Owing to back water effect of temporary dam the table is not applicable after July 31, 1904.

Estimated monthly discharge of Carson River (East Fork) near Gardnerville, Nev., for 1904.

[Drainage area, 381 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	47	18	31.9	1,962	0.084	0.097
February	3,310	43	585	33,650	1.54	1.66
March	1,000	318	602	37,020	1.58	1.82
April	1,592	397	816	48,560	2.14	2.39
May	3,112	422	1,984	122,100	5.21	6.01
June	2,410	.69	1,041	61,940	2.74	3.06
July	1,034	364	663	40,770	1.74	2.01
The period				345,900		

CARSON RIVER NEAR EMPIRE, NEV.

This station was established October 21, 1900, by L. H. Taylor. The original gage was located upstream from the site of the present station. On February 18, 1901, the erosion of a bar in the channel above the gage caused a division of the stream into two channels. On this account the present gage was installed on March 13, 1901. It is located about three-fourths mile east of Brunswick Mill and 2½ miles east of Empire, Nev. The gage is an inclined 4 by 4 inch timber spiked to a cottonwood stump on the left bank. The gage datum was lowered 1.3 feet August 11, 1903, to enable readings to be made at extreme low water. It is read once each day by David Lloyd. Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is zero of the tagged wire on the left bank. The channel is straight for 100 feet above and below the station. Both banks are high, rocky, and will not overflow. The bed of the stream is composed of solid rock, gravel, and cobblestones and is not likely to shift. At flood stages the stream is too deep and swift to obtain the best results. At low water the stream is sluggish at the cable, and measurements are made by wading, one-fourth mile below. Bench mark No. 1 is the top of a bowlder on the left bank 2 feet west of the gage. Its elevation is 7.10 feet above the zero of the gage, as originally established, and 8.40 feet above the zero of the gage in its present position. Bench mark No. 2 is the top of a bowlder on the left bank 10 feet north of the gage. Its elevation is 8.38 feet above the zero of the gage, as originally established, and 9.68 feet above the zero of the gage in its present position.

The observations at this station during 1904 have been made under the direction of A. E. Chandler, district hydrographer.

Discharge measurements of Carson River near Empire, Nev., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 28	L. A. Wooley	80	288	3.39	4.62	976
April 30	R. A. Craig	70	261	3.15	4.10	821
May 7	do	68	289	3.99	4.72	1,154
July 1	J. T. Shaw	80	337	3.86	4.70	1,302
July 9	do	84	291	3.14	4.35	913
July 16	do	79	233	2.30	3.64	536
July 23	do	74	229	2.34	3.64	537
July 30	do	66	192	1.79	3.15	344
August 6	do	62	147	1.31	2.69	193
August 13	do		139	1.06	2.45	147
August 27	do		119	.84	2.18	100
September 14	do		20	2.30	1.90	46
October 28	do		199	1.79	3.20	355

Mean daily gage height, in feet, of Carson River near Empire, Nev., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	De
1	2.80	2.60	4.30	4.30	4.10	5.80	4.70	3.00	2.10	3.00	3.10	
2	2.80	2.60	4.10	4.20	4.10	5.70	4.70	2.90	2.00	3.40	3.10	
3	2.80	2.70	4.30	4.10	4.00	5.80	4.60	2.90	2.00	3.40	3.10	
4	2.80	2.70	4.30	4.00	4.00	6.00	4.40	2.80	2.00	3.10	3.10	
5	2.80	2.70	4.30	4.00	4.20	5.90	4.20	2.80	2.00	3.10	3.10	
6	2.80	2.80	4.10	4.00	4.40	5.70	4.30	2.70	2.00	3.00	3.00	
7	2.80	2.70	4.10	4.10	4.90	5.90	4.40	2.50	2.00	3.10	3.00	
8	2.70	2.60	4.40	4.10	5.00	5.90	4.30	2.30	2.00	3.52	3.00	
9	2.70	2.60	4.50	4.20	5.20	5.70	4.30	2.30	1.90	3.50	3.00	
10	2.70	2.60	4.70	4.30	5.40	5.50	4.20	2.40	1.80	3.40	3.00	
11	2.70	2.70	5.00	4.50	5.60	5.80	4.10	2.40	1.70	3.40	3.00	
12	2.70	3.30	4.90	4.80	5.80	5.60	4.00	2.40	1.70	4.40	3.00	
13	2.70	4.00	4.70	5.00	5.90	5.60	3.90	2.50	1.70	4.00	3.00	
14	2.70	3.60	4.50	5.30	6.10	5.50	3.80	2.50	1.70	3.80	3.00	
15	2.70	3.20	4.30	5.60	6.30	5.50	3.80	2.30	1.80	3.70	3.00	
16	2.70	4.20	4.10	5.80	6.40	5.60	3.50	2.20	1.90	3.60	2.90	
17	2.70	5.20	4.00	5.10	6.30	5.60	3.40	2.20	2.00	3.52	2.90	
18	2.70	3.80	4.00	4.90	6.30	5.50	3.40	2.30	2.00	3.40	2.90	
19	2.60	3.40	4.60	5.00	6.20	5.40	3.40	2.40	2.00	3.30	2.90	
20	2.60	3.30	5.10	4.90	5.90	5.30	3.40	2.50	2.00	3.30	2.90	
21	2.60	3.20	5.60	4.80	5.70	5.40	3.40	2.40	2.00	3.30	2.80	
22	2.60	3.80	4.90	4.70	5.80	5.30	3.50	2.30	2.00	3.30	2.80	
23	2.60	5.00	4.60	4.50	6.20	5.30	3.60	2.30	2.10	3.30	2.80	
24	2.60	5.80	4.40	4.40	6.60	5.30	3.50	2.30	2.10	3.30	2.80	
25	2.50	6.90	4.30	4.30	6.60	5.10	3.50	2.20	2.40	3.30	2.80	
26	2.50	6.70	4.30	4.40	6.80	4.90	3.40	2.20	2.50	3.20	2.90	
27	2.50	5.30	4.30	4.40	6.20	4.80	3.40	2.20	2.80	3.20	2.90	
28	2.40	5.00	4.40	4.30	5.80	4.80	3.40	2.20	2.70	3.20	2.90	
29	2.40	4.50	4.60	4.20	5.60	4.80	3.30	2.30	2.70	3.10	2.80	
30	2.50	.....	4.80	4.20	5.80	4.70	3.10	2.30	2.80	3.10	2.90	
31	2.60	.....	4.50	.....	5.80	.....	3.10	2.20	.....	3.10	.....	

Rating table for Carson River near Empire, Nev., from January 1, 1904, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	30	2.90	251	4.10	765	5.30	1,700
1.80	40	3.00	281	4.20	825	5.40	1,790
1.90	51	3.10	313	4.30	889	5.50	1,885
2.00	63	3.20	347	4.40	956	5.60	1,980
2.10	77	3.30	384	4.50	1,026	5.70	2,075
2.20	93	3.40	423	4.60	1,100	5.80	2,170
2.30	110	3.50	464	4.70	1,180	5.90	2,265
2.40	129	3.60	508	4.80	1,260	6.00	2,360
2.50	150	3.70	554	4.90	1,345	6.20	2,550
2.60	173	3.80	603	5.00	1,430	6.40	2,735
2.70	197	3.90	654	5.10	1,520	6.60	2,925
2.80	223	4.00	708	5.20	1,610	6.80	3,120

The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.70 feet and 5.40 feet. The table has been extended above gage height 5.40 feet.

Estimated monthly discharge of Carson River near Empire, Nev., for 1904.

[Drainage area, 988 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	223	129	187	11,500	0.189	0.218
February	3,250	173	792	45,560	.802	.865
March	1,980	708	1,035	63,640	1.05	1.21
April	2,170	708	1,094	65,100	1.11	1.24
May	3,150	708	2,006	123,300	2.03	2.34
June	2,360	1,180	1,852	110,200	1.87	2.09
July	1,180	313	638	39,230	.646	.745
August	281	93	139	8,547	.141	.163
September	223	30	82.4	4,903	.083	.093
October	956	281	420	25,820	.425	.490
November	313	223	267	15,890	.270	.301
December	423	197	229	14,080	.232	.268
The year	3,250	30	728	527,800	.737	10.02

SUSAN RIVER NEAR SUSANVILLE, CAL.

This station was established June 3, 1900, by L. H. Taylor, at which time a temporary gage was installed on the right bank. It is located about three-fourths mile southwest of Susanville, at the electric-light plant. A short distance above the station a small irrigating ditch, known as the "Masten ditch," is taken out on the right bank. There is a flume near its head in which a gage has been placed. On December 20, 1903, the station at the electric-light plant was reestablished by H. E. Green. A new gage was set which was made to read 2 feet more than original gage. A cable was installed for high-water measurements. The initial point for soundings is a post in the fence in line with the cable. The cable support on the left bank is 34.8 feet from the initial point for soundings. The channel is straight for 150 feet above and for 250 feet below the cable. The current is swift. There is a riffle immediately above the cable. The right bank is high and is composed of clay covered with vegetation. It is not liable to overflow. The left bank is low, liable to overflow, and is covered with a sparse growth of willows. The bed of the stream is composed of gravel and cobblestones and is permanent. Bench mark No. 1 is a nail in the fence post, which is used as the initial point for soundings. Its elevation is 11.35 feet above the zero of the gage. Bench mark No. 2 is a nail in the cable post. Its elevation is 9.00 feet above the zero of the gage. Bench mark No. 3 is a nail in the cottonwood tree

to which the cable is attached. Its elevation is 10.00 feet above the zero of the gage. The gage is read once each day by James Branham.

The observations at this station during 1904 have been made under the direction of S. G. Bennett and W. B. Clapp, district hydrographers.

Discharge measurements of Susan River near Susanville, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
February 21	James Branham	5.30	106
February 28	do	6.40	286
March 29	do	7.55	710
June 16	S. G. Bennett and J. S. Evans	5.60	180
June 29	James Branham	4.95	96
July 31	do	4.20	27
August 10	do	4.50	50
September 11	do	3.85	11
October 25	W. B. Clapp and J. Y. Toler	4.10	25

Mean daily gage height, in feet, of Susan River near Susanville, Cal., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.30	4.20	6.20	6.85	6.25	6.05	4.90	4.10	3.90	4.00	4.10	4.2
2	4.25	4.20	6.80	6.90	6.15	6.00	5.20	4.10	3.85	4.00	4.20	4.2
3	4.25	4.20	7.00	6.90	6.15	5.95	5.20	4.05	3.80	4.00	4.10	4.2
4	4.25	4.20	7.55	7.05	6.20	5.90	5.20	4.20	3.80	4.00	4.10	4.1
5	4.20	4.25	7.20	7.00	6.30	5.90	5.10	4.50	3.80	4.00	4.10	4.1
6	4.20	4.25	7.45	7.15	6.85	5.80	5.15	4.50	3.80	4.00	4.10	4.1
7	4.20	4.25	7.80	7.15	7.30	5.80	5.10	4.50	3.80	4.10	4.10	4.1
8	4.20	4.25	8.70	7.30	7.35	5.75	4.65	4.50	3.80	4.10	4.10	4.1
9	4.20	4.25	7.75	7.45	7.50	5.70	4.50	4.50	3.80	4.10	4.10	4.1
10	4.25	4.25	7.50	7.80	7.55	5.70	4.50	4.50	3.80	4.20	4.10	4.1
11	4.30	4.25	7.00	8.05	7.80	5.60	4.40	4.40	3.90	4.55	4.10	4.0
12	4.30	4.30	6.70	8.25	7.95	5.50	4.40	4.40	3.95	4.40	4.10	4.1
13	4.30	4.30	6.45	8.60	8.15	5.50	4.35	4.40	3.95	4.30	4.10	4
14	4.30	4.30	6.55	8.80	8.20	5.50	4.30	4.40	3.95	4.30	4.10	4.1
15	4.25	5.60	6.70	8.95	8.10	5.45	4.30	4.40	3.95	4.20	4.10	4
16	4.25	9.00	6.35	8.50	8.05	5.50	4.30	4.40	3.95	4.25	4.20	4.1
17	4.25	6.70	7.85	8.25	7.90	5.50	4.30	4.40	3.95	4.25	4.20	4.1
18	4.25	6.20	8.80	8.25	7.85	5.40	4.30	4.40	3.95	4.20	4.15	4
19	4.25	5.65	9.00	8.30	7.55	5.40	4.30	4.40	4.00	4.20	4.15	4.1
20	4.30	5.35	8.45	7.75	7.40	5.35	4.30	4.40	4.00	4.15	4.15	4.0
21	4.30	5.85	7.75	7.45	7.40	5.30	4.25	4.40	4.00	4.15	4.10	4.0
22	4.30	9.90	7.45	7.25	7.30	5.30	4.20	4.40	4.00	4.10	4.10	4.0
23	4.30	7.85	7.10	7.05	7.30	5.30	4.20	4.40	4.20	4.10	4.10	4.0
24	4.30	9.65	6.80	6.90	7.30	5.30	4.30	4.40	4.40	4.10	4.10	4.0
25	4.30	8.20	6.70	6.85	7.20	5.20	4.60	4.40	4.30	4.10	4.10	4
26	4.30	7.50	6.65	6.80	7.05	5.10	4.55	4.25	4.20	4.10	4.10	4.0
27	4.25	6.95	6.70	6.75	6.80	5.00	4.50	4.00	4.10	4.10	4.25	4
28	4.20	6.40	7.85	6.65	6.70	5.00	4.45	4.00	4.10	4.10	4.20	4.0
29	4.20	6.20	7.55	6.65	6.50	4.90	4.45	3.95	4.05	4.10	4.20	4.0
30	4.20	.....	7.30	6.25	6.40	4.90	4.40	3.90	4.05	4.10	4.20	4
31	4.20	.....	6.95	.....	6.25	.....	4.25	3.90	.....	4.10	.....	.....

Rating table for Susan River near Susanville, Cal., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	6	5.00	92	6.40	350	7.70	760
3.70	8	5.10	104	6.50	375	7.80	800
3.80	10	5.20	116	6.60	400	7.90	840
3.90	13	5.30	128	6.70	430	8.00	880
4.00	16	5.40	142	6.80	460	8.20	960
4.10	20	5.50	156	6.90	490	8.40	1,040
4.20	24	5.60	172	7.00	520	8.60	1,120
4.30	30	5.70	190	7.10	550	8.80	1,200
4.40	36	5.80	210	7.20	585	9.00	1,300
4.50	42	5.90	230	7.30	620	9.20	1,400
4.60	50	6.00	250	7.40	655	9.40	1,500
4.70	60	6.10	275	7.50	690	9.60	1,600
4.80	70	6.20	300	7.60	725	9.80	1,700
4.90	80	6.30	325				

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 4.00 feet and 7.50 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Susan River near Susanville, Cal., 1903 and 1904.

[Drainage area, 256 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
January	388	36	90	5,534	0.35	0.40
March	1,800	36	205	12,605	.80	.92
April	620	288	372	22,136	1.45	1.62
May	445	122	266	16,356	1.04	1.20
June	116	20	63	3,749	.25	.28
July	20	6	11	676	.04	.05
August	8	6	7	430	.03	.03
September	12	8	11	655	.04	.05
October	18	12	17	1,045	.07	.08
November	725	18	137	8,152	.54	.60
December	92	30	42	2,582	.16	.18
The period				73,920		

NOTE.—River frozen during February.

Estimated monthly discharge of Susan River near Susanville, Cal., 1903 and 1904—Con.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
January	30	24	27	1,660	0.11	0.13
February	1,750	24	349	20,075	1.36	1.47
March	,300	300	629	38,676	2.46	2.84
April	1,275	312	695	41,355	2.71	3.02
May	960	288	600	36,893	2.34	2.70
June	262	80	160	9,521	.62	.69
July	116	27	51	3,136	.20	.23
August	42	13	31	1,906	.12	.14
September	36	10	16	952	.06	.07
October	46	16	22	1,353	.09	.10
November	27	20	21	1,250	.08	.09
December	725	16	47	2,890	.18	.21
The year	1,750	10	221	159,667	.86	11.62

WILLOW CREEK AT MERRILLVILLE, CAL.

This station was established June 18, 1904, by S. G. Bennett. It is located at the old bridge 100 feet above the present wagon bridge. The gage is a 2 by 4 inch vertical rod fastened to the left end of the bridge. It is read once each day by R. W. Hurlbut. Discharge measurements are made from the bridge. The initial point for soundings is on the left bank of the stream. The distance across the stream is marked on the foot bridge at intervals of 2 feet. The channel is straight above and below the bridge for a distance of 100 feet. The banks on each side are low, but not subject to overflow, as there is very little fluctuation in the discharge of the creek. The bed of the stream is composed of gravel and is not subject to much change.

The observations at this station during 1904 have been made under the direction of S. G. Bennett and W. B. Clapp, district hydrographers.

Discharge measurements of Willow Creek at Merrillville, Cal., in 1904.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
June 18	S. G. Bennett	1.00	19.1
July 17	James Branham	.95	14.9
August 29	....do	1.05	17.9
October 25	J. Y. Toler and W. B. Clapp	1.07	19.3

Mean daily gage height, in feet, of Willow Creek at Merrillville, Cal., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	1.00	1.00	1.05	1.10	1.10
2	1.00	1.00	1.10	1.05	1.10	1.10
3	1.00	1.05	1.10	1.05	1.10	1.05
4	1.00	1.00	1.05	1.05	1.10	1.05
5	1.00	1.00	1.05	1.05	1.10	1.05
6	1.05	1.00	1.05	1.10	1.05	1.05
7	1.00	.95	1.10	1.10	1.10	1.05
8	1.00	1.05	1.05	1.05	1.05	1.05
9	1.00	1.05	1.05	1.10	1.10	1.10
10	.95	1.00	1.10	1.10	1.10	1.05
11	1.10	1.00	1.05	1.05	1.10	1.05
12	1.15	1.00	1.00	1.05	1.10	1.05
13	1.20	1.00	1.00	1.05	1.10	1.10
14	1.10	1.00	1.05	1.10	1.10	1.10
15	1.10	1.00	1.05	1.20	1.10	1.05
16	1.10	1.00	1.05	1.10	1.10	1.05
17	1.00	1.05	1.05	1.05	1.05	1.05
18	1.00	1.00	1.05	1.05	1.10	1.05
19	1.00	1.00	1.00	1.05	1.10	1.05
20	1.00	1.00	1.00	1.05	1.10	1.05
21	1.05	1.00	1.05	1.05	1.10	1.05
22	1.00	1.00	1.05	1.05	1.10	1.05
23	1.00	1.00	1.10	1.05	1.05	1.10
24	1.00	1.00	1.10	1.05	1.05	1.10
25	1.00	1.05	1.10	1.05	1.05	1.05
26	1.00	1.00	1.05	1.05	1.05	1.00
27	1.00	1.00	1.05	1.10	1.10	1.05
28	1.00	1.00	1.05	1.05	1.10	1.05
29	1.05	1.00	1.05	1.10	1.10	1.20
30	1.00	1.05	1.00	1.10	1.10	1.70
31	1.00	1.00	.....	1.10	.....	1.20

Rating table for Willow Creek at Merrillville, Cal., from July 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	16	1.00	18	1.10	20	1.20	22

Estimated monthly discharge of Willow Creek at Merrillville, Cal., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July	22	17	19	1,168
August	19	17	18	1,107
September	20	18	19	1,131
October	22	19	19	1,168
November	20	19	20	1,190
December	50	19	20	1,230
The period	50	17	19	6,994

SILVER CREEK NEAR SILVERLAKE, OREG.

This station was established December 29, 1904, by W. C. Sawyer. It is located 0.9 mile above the county highway bridge and 1.6 miles southwest of Silverlake post-office, Oreg. An inclined staff gage, 16 feet long, is fastened at the east bank. The slope of the gage is 2.25 feet to 1 foot vertical. The gage is read once each day by Henry Egli. Discharge measurements are made by means of a cable and car. The initial point for soundings is 9.2 feet west from the anchor bolt at the east end of the cable. The channel is straight for 100 feet above and 75 feet below the station. The current is swift. Both banks are high, rocky, clean, and do not overflow. The bed of the stream is composed of rock and gravel, free from vegetation, and permanent. There is but one channel at all stages. The bench mark is a copper bolt cemented in solid rock on the east side of the stream, 43 feet downstream from the cable, and 12 feet from the edge of low water. Its elevation is 8.12 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of John T. Whistler, district engineer.

MALHEUR LAKE AT THE NARROWS, OREGON.

This station was established May 14, 1903, by N. S. Dils. It is located at the highway bridge across The Narrows. The gage is a 1 by 4 inch board 10 feet long, fastened to a telegraph pole. It is read from the bridge once each day by C. A. Haines, the postmaster. The bench mark is a United States Geological Survey standard iron bench-mark post set at the east end of the bridge on the south side of the road near the fence and about 200 feet from the gage. Its elevation is 8.20 feet above the zero of the gage and 4,088 feet above sea level. This station is maintained for the purpose of obtaining data of

the lake fluctuations. The lake has no outlet. No discharge measurements are made at this station.

The observations at this station during 1904 have been made under the direction of John T. Whistler, district engineer.

Mean daily gage height, in feet, of Malheur Lake at The Narrows, Oregon, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.80	1.60	1.90	5.60	.....	7.00	6.70	6.30	5.70	5.40	5.60
2	1.70	1.60	1.90	5.70	.....	7.00	6.70	6.30	5.70	5.40	5.60
3	1.70	1.60	1.90	5.80	.....	7.00	6.70	6.20	5.70	5.40	5.60
4	1.70	1.60	1.90	5.90	.....	7.00	6.70	6.20	5.70	5.40	5.60
5	1.70	1.60	1.90	5.90	.....	7.00	6.70	6.20	5.70	5.40	5.60
6	1.70	1.60	2.00	6.00	.....	7.00	6.60	6.20	5.60	5.40	5.60
7	1.70	1.70	2.00	6.00	.....	7.00	6.60	6.20	5.60	5.40	5.60
8	1.70	1.70	2.00	6.10	7.20	7.00	6.60	6.20	5.50	5.40	5.60
9	1.70	1.70	2.00	6.10	7.20	7.00	6.60	6.20	5.50	5.40	5.60
10	1.70	1.70	2.00	6.20	7.20	7.00	6.60	6.10	5.50	5.40	5.60
11	1.70	1.70	2.00	6.20	7.20	7.00	6.60	6.10	5.50	5.40	5.60
12	1.70	1.70	2.00	6.30	7.30	6.90	6.60	6.10	5.50	5.40	5.60
13	1.70	1.70	2.10	6.30	7.30	6.90	6.50	6.10	5.50	5.40	5.60
14	1.70	1.80	2.10	6.40	7.30	6.90	6.50	6.00	5.40	5.40	5.60
15	1.70	1.80	2.20	6.40	7.30	6.90	6.50	6.00	5.40	5.40	5.60
16	1.70	1.80	2.20	6.40	7.30	6.80	6.50	6.00	5.40	5.40	5.60
17	1.60	1.80	2.30	6.50	7.20	6.80	6.50	6.00	5.40	5.40	5.60
18	1.60	1.80	2.30	6.50	7.20	6.80	6.50	5.90	5.40	5.30	5.70
19	1.60	1.80	2.30	6.60	7.10	6.80	6.50	5.90	5.40	5.30	5.10
20	1.60	1.80	2.40	6.60	7.10	6.80	6.45	5.90	5.40	5.30	5.10
21	1.60	1.90	2.40	6.70	7.10	6.80	6.45	5.90	5.40	5.30	.....
22	1.60	1.90	2.40	6.70	7.10	6.80	6.45	5.90	5.40	5.30	.....
23	1.60	1.90	2.50	6.80	7.10	6.80	6.45	5.90	5.40	5.30	.....
24	1.60	1.90	2.50	6.90	7.10	6.80	6.45	5.80	5.40	5.30	.....
25	1.60	1.90	2.50	7.00	7.10	6.80	6.45	5.80	5.40	5.30	.....
26	1.60	1.90	2.50	7.10	7.10	6.80	6.45	5.80	5.40	5.30	.....
27	1.60	1.90	2.60	7.10	7.10	6.80	6.45	5.80	5.40	5.30	.....
28	1.60	1.90	5.10	7.20	7.10	6.80	6.40	5.80	5.40	5.30	.....
29	1.60	1.90	5.10	7.20	7.10	6.70	6.40	5.80	5.40	5.30	.....
30	1.60	.....	5.30	7.20	7.10	6.70	6.40	5.80	5.40	5.30	.....
31	1.60	.....	5.40	.....	7.10	.....	6.30	5.70	.....	5.30	.....

SILVIES RIVER NEAR SILVIES, OREG.

A temporary station was established May 8, 1903, by N. S. Dils, one-half mile above the present gage. Gage heights were read by John Craddock from May 8 to June 26, 1903. One discharge measurement was made at the temporary station. On June 16, 1903, a permanent gage was established by M. D. Williams at the proposed dam site one-half mile below the temporary gage. The station is 2 miles west of the stage road and three-fourths mile below the mouth of Trout Creek. There is a dam 1½ miles upstream. The gage is an inclined 2 by 6 inch plank on the left bank. It is read once each day by John Craddock. Discharge measurements are made by means of

a §-inch cable having a total span of 494 feet. It is supported near the center. The cable is located 75 feet downstream from the gage. The initial point for soundings is the zero on the tagged wire, 29 feet from the cable support. The channel is straight for 150 feet above and for 200 feet below the station. The right bank is low and will overflow at high water for a considerable distance. The left bank is high, rocky, and is not liable to overflow. All water passes beneath the cable at all stages. The bed of the stream is composed of gravel, free from vegetation, and liable to shift. No bench mark has been established.

The observations at this station during 1904 have been made under the direction of John T. Whistler, district engineer.

Discharge measurements of Silvies River near Silvies, Oreg., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet*
March 12	M. L. Lewis	265	1.40	6.35	375
March 13	do	240	1.40	5.80	336
March 22	do	295	1.60	6.86	460
April 2	do	181	1.76	5.75	319
April 8	do	425	1.52	8.65	647
April 8	do	415	1.57	8.40	653
April 9	do	393	1.78	8.91	699
April 10	do	591	1.63	8.99	965
April 13	J. H. and M. L. Lewis	1,590	1.18	11.30	1,870
April 28	M. L. Lewis	1,030	1.10	10.02	1,170
May 7	do	402	1.80	8.65	723
May 13	do	333	1.60	7.58	534
May 24	do	248	1.50	6.05	371
June 2	do	216	1.21	5.44	262
June 9	do	197	1.16	4.98	229
June 16	do	143	.80	3.80	115
June 29	W. C. Sawyer	30	1.13	2.94	34
September 15 [a]	do	3.3	1.18	2.22	3.9
November 5	Ivan Landes	27	.53	2.80	14

[a] Wading at different section.

Mean daily gage height, in feet, of Silvies River near Silvies, Oreg., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.20	3.40	4.45	5.85	9.85	5.25	2.80	2.60	2.25	2.60	2.85	2.95
2	3.20	3.40	4.35	5.40	9.85	5.40	2.85	2.60	2.25	2.60	2.85	2.95
3	3.20	3.55	3.95	6.85	9.75	5.35	3.00	2.60	2.25	2.60	2.85	2.95
4	3.20	3.65	3.95	6.65	9.10	5.25	3.10	2.60	2.20	2.60	2.85	3.50
5	3.20	3.65	3.95	6.85	8.95	5.05	3.15	2.50	2.20	2.65	2.85	3.50
6	3.20	3.65	5.85	6.85	8.80	5.05	3.20	2.50	2.20	2.70	2.85	3.50
7	3.20	3.65	8.40	8.80	8.65	5.00	3.25	2.50	2.20	2.75	2.85	3.00
8	3.20	3.65	9.85	8.75	8.50	5.05	3.20	2.45	2.20	2.75	2.85	3.00
9	3.20	3.65	8.90	9.20	8.40	5.00	3.20	2.40	2.20	2.80	2.80	3.00
10	3.20	3.65	8.10	10.15	8.30	4.65	3.20	2.40	2.20	2.80	2.80	3.00
11	3.20	3.65	6.85	10.30	8.05	4.45	3.10	2.40	2.20	2.80	2.80	3.00
12	3.20	3.65	6.35	10.60	7.90	4.40	3.10	2.40	2.20	2.85	2.80	3.00
13	3.20	3.65	6.35	11.10	7.80	4.30	3.10	2.35	2.20	2.85	2.80	3.00
14	3.20	3.65	6.65	12.05	7.35	4.05	3.10	2.35	2.20	2.85	2.80	3.00
15	3.20	8.70	6.85	12.10	7.15	4.05	3.10	2.35	2.20	2.85	2.80	3.00
16	3.20	8.50	6.85	12.15	7.05	3.80	2.95	2.30	2.20	2.85	2.85	3.00
17	3.20	6.45	6.25	11.75	6.85	3.95	3.00	2.30	2.20	2.85	2.90	3.00
18	3.20	4.35	6.20	11.50	6.75	3.75	3.00	2.20	2.20	2.85	2.90	3.25
19	3.20	3.65	6.85	11.10	6.65	3.50	3.00	2.20	2.25	2.85	2.90	3.20
20	3.20	3.65	7.05	11.20	6.45	3.50	3.00	2.20	2.30	2.85	2.95	3.20
21	3.20	3.65	6.45	11.00	6.35	3.40	2.90	2.20	2.30	2.85	2.95	3.20
22	3.20	9.45	5.65	10.80	6.35	3.40	2.85	2.20	2.30	2.85	2.95	3.20
23	3.20	10.80	4.90	10.50	6.25	3.35	2.80	2.30	2.30	2.85	2.95	3.20
24	3.40	8.80	4.55	9.95	6.15	3.30	2.80	2.30	2.30	2.85	2.95	3.20
25	3.40	7.90	4.85	9.95	6.10	3.30	2.80	2.25	2.30	2.85	2.95	3.20
26	3.40	7.45	4.85	9.85	6.05	3.25	2.75	2.25	2.35	2.85	2.95	3.20
27	3.40	5.95	4.85	9.75	5.85	3.10	2.70	2.25	2.40	2.85	2.95	3.20
28	3.40	5.05	4.85	9.85	5.65	3.50	2.60	2.25	2.45	2.85	2.95	3.20
29	3.40	4.85	5.45	9.85	5.45	2.95	2.55	2.25	2.50	2.85	2.95	3.20
30	3.40	.....	6.35	9.85	5.30	2.85	2.50	2.25	2.60	2.85	2.95	3.20
31	3.40	.....	6.45	.....	5.25	.....	2.50	2.25	.....	2.85	.....	4.10

Rating table for Silvies River near Silvies, Oreg., from January 1, 1904, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	3	3.60	78	4.90	208	6.20	358
2.30	5	3.70	87	5.00	220	6.30	369
2.40	7	3.80	97	5.10	231	6.40	381
2.50	9	3.90	107	5.20	242	6.50	393
2.60	12	4.00	117	5.30	254	6.60	405
2.70	16	4.10	127	5.40	265	6.70	417
2.80	20	4.20	137	5.50	276	6.80	429
2.90	25	4.30	147	5.60	288	6.90	441
3.00	31	4.40	157	5.70	299	7.00	453
3.10	37	4.50	167	5.80	311	7.20	477
3.20	45	4.60	177	5.90	322	7.40	502
3.30	53	4.70	187	6.00	334	7.60	526
3.40	62	4.80	197	6.10	346	7.80	551
3.50	70						

Rating table for Silvies River near Silvies, Oreg., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet*
8.00	576	8.80	724	9.60	966	11.00	1,700
8.20	607	9.00	773	9.80	1,064	11.50	1,967
8.40	642	9.20	827	10.00	1,168	12.00	2,236
8.60	681	9.40	889	10.50	1,432		

The above table is applicable only for open-channel conditions. It is based upon 19 discharge measurements made during 1904. It is well defined between gage heights 2.20 feet and 10.00 feet. Above 10.00 feet the curve depends on one measurement at 11.00 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Silvies River near Silvies, Oreg., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	62	45	49.4	3,038
February	1,592	62	286	16,460
March	1,090	112	355	21,830
April	2,316	265	1,242	73,910
May	1,090	248	530	32,590
June	265	22	132	7,855
July	49	9	29.0	1,783
August	12	3	6.2	381
September	12	3	4.4	262
October	22	12	19.8	1,218
November	28	20	24.0	1,428
December	127	28	43.6	2,681
The year	2,316	3	227	163,400

SILVIES RIVER NEAR BURNS, OREG.

This station was established as a temporary station by N. S. Dils, May 10, 1903. The permanent station was established August 11, 1903, by W. T. Turner. It is located about 10 miles above Burns, Oreg. On January 19, 1904, a new gage was installed together with a cable for discharge measurements by John H. Lewis. The present gage is on the left bank, 10 feet below the bridge, near Parker's house. The lower inclined section reads from 2 to 12.6 feet. The upper vertical section reads from 12.7 to 17 feet. Both sections consist of 2 by 6 inch timbers, supported by a frame which is secured to the bank. The gage is read once each day by Mrs. Leonia Parker. Discharge measurements are made from a ⅜-inch cable with a span of 390

feet. It is located at Lampshir's place, 1 mile above the gage. Besides the timber supports at the ends of the cable it is supported at a point 167 feet from the initial point for soundings by a tree 10 inches in diameter. At high stages all water will pass beneath the cable. At low water the current is sluggish at the cable and discharge measurements are made by wading. The initial point for soundings is the zero of the tagged wire 22½ feet from the lower end of the turn-buckle. The channel is straight for 75 feet above and below the cable. The right bank is low and liable to overflow for a considerable distance. The left bank is high and rocky and will not overflow. Both banks have been cleared of brush. At the cable the bed of the stream is composed of sand, and is liable to shift. There is one channel at low water and two or more at high water. At the gage the bed of the stream is composed of clean sand and gravel. The bench mark is the highest point of a large rock on the right bank, directly across the river from the gage, from which it is 135 feet distant. Its elevation is 19.76 feet above the zero of the gage. The present gage was established on the same datum as the one which it replaced.

The observations at this station during 1904 have been made under the direction of John T. Whistler, district engineer.

Discharge measurements of Silvies River near Burns, Oreg., in 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
January 19	J. H. Lewis	26	29	1.50	2.85	[a]44
March 15	M. L. Lewis	56	546	1.15	9.30	630
March 25	do	52	400	.87	6.60	348
April 5	do	77	760	1.50	13.30	1,141
April 6	do	80	704	1.83	13.60	1,290
April 11	do	375	1,346	2.11	15.20	2,847
April 12	do	379	1,500	2.29	16.10	3,430
April 15	J. H. and M. L. Lewis.	434	2,350	2.10	17.10	4,925
May 5	M. L. Lewis	290	1,260	1.25	14.30	1,576
May 20	do	72	658	1.35	11.50	887
May 29	do	55	435	1.08	7.50	468
June 8	do	53	375	.98	5.80	342
June 12	do	52	338	.83	5.20	280
June 20	do	50	259	.56	3.75	144
June 23	do	50	232	.42	3.42	98
September 8	Sawyer & Lewis.	22	18	1.00	2.60	18
November 6	Landes & Hoyt.	44	45	1.10	2.80	49

[a] Wading at different section.

Mean daily gage height, in feet, of Silvies River near Burns, Oreg., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	D.
1	2.50	2.75	5.25	9.25	14.90	6.90	3.10	2.85	2.60	2.70	2.80	.
2	2.50	2.75	5.20	10.30	14.72	6.90	2.90	2.85	2.60	2.70	2.80	.
3	2.50	2.75	5.10	11.20	14.50	6.90	2.90	2.83	2.60	2.70	2.80	.
4	2.50	2.75	5.00	12.38	14.40	6.85	2.90	2.82	2.60	2.70	2.80	.
5	2.50	2.75	5.50	13.10	14.30	6.90	2.90	2.80	2.60	2.70	2.80	.
6	2.50	2.80	6.25	13.40	14.30	6.40	2.90	2.80	2.60	2.70	2.80	.
7	2.50	2.80	12.20	13.82	13.90	6.00	3.00	2.80	2.60	2.70	2.80	.
8	2.50	2.80	16.10	13.85	13.80	5.92	3.00	2.75	2.60	2.70	2.80	.
9	2.50	2.80	15.60	14.25	13.67	5.90	3.05	2.70	2.60	2.75	2.80	.
10	2.50	2.80	13.80	14.65	13.52	5.65	3.05	2.70	2.60	2.75	2.80	.
11	2.50	2.80	11.90	15.45	13.40	5.45	3.10	2.70	2.60	2.75	2.80	.
12	2.50	2.80	10.00	16.20	13.20	5.40	3.10	2.70	2.60	2.80	2.80	.
13	2.50	2.80	8.65	16.65	12.90	5.22	3.15	2.70	2.60	2.80	2.80	.
14	2.90	2.80	8.30	17.00	12.67	4.92	3.15	2.70	2.60	2.80	2.80	.
15	2.90	2.80	9.30	17.12	12.40	4.45	3.20	2.60	2.60	2.80	2.80	.
16	2.90	3.30	9.30	16.70	12.10	4.28	3.20	2.60	2.60	2.80	2.80	.
17	2.90	7.00	8.75	16.40	11.72	4.10	3.15	2.60	2.60	2.80	2.80	.
18	2.90	7.60	11.20	16.00	11.50	4.00	3.10	2.60	2.60	2.80	2.80	.
19	2.90	5.75	11.70	15.90	11.18	3.88	3.10	2.60	2.60	2.80	2.80	.
20	2.85	4.80	13.20	15.90	11.10	3.75	3.00	2.60	2.60	2.80	2.80	.
21	2.85	4.25	13.00	15.70	10.90	3.62	2.95	2.60	2.60	2.80	2.80	.
22	2.85	9.70	10.70	15.60	10.40	3.55	2.90	2.60	2.60	2.80	2.80	.
23	2.85	12.50	10.10	15.40	9.45	3.40	2.90	2.60	2.60	2.80	2.80	.
24	2.85	12.90	8.20	15.10	9.00	3.35	2.90	2.60	2.60	2.80	2.80	.
25	2.85	12.80	6.95	14.60	8.50	3.30	2.90	2.60	2.60	2.80	2.80	.
26	2.80	11.80	6.40	14.20	8.30	3.25	2.90	2.65	2.60	2.80	2.80	.
27	2.80	9.80	6.00	14.00	8.15	3.10	2.90	2.65	2.70	2.75	2.80	.
28	2.80	7.20	6.85	14.20	8.00	3.00	2.85	2.65	2.75	2.75	2.80	.
29	2.80	5.80	8.45	14.90	7.45	3.00	2.85	2.60	2.70	2.75	2.80	.
30	2.80	.....	10.72	15.00	7.10	3.00	2.85	2.60	2.70	2.80	2.80	.
31	2.75	.....	9.70	.....	6.90	.....	2.85	2.60	.....	2.80	.....	.

Rating table for Silvies River near Burns, Oreg., from January 1, 1904, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	6	4.10	152	6.40	363	10.50	750
2.60	15	4.20	161	6.60	382	11.00	805
2.70	24	4.30	170	6.80	400	11.50	865
2.80	33	4.40	179	7.00	419	12.00	930
2.90	42	4.50	189	7.20	437	12.50	1,005
3.00	51	4.60	198	7.40	455	13.00	1,095
3.10	60	4.70	207	7.60	474	13.50	1,220
3.20	69	4.80	216	7.80	493	14.00	1,440
3.30	78	4.90	225	8.00	512	14.50	1,900
3.40	87	5.00	235	8.20	530	15.00	2,440
3.50	97	5.20	253	8.40	549	15.50	2,980
3.60	106	5.40	271	8.60	568	16.00	3,520
3.70	115	5.60	290	8.80	587	16.50	4,060
3.80	124	5.80	308	9.00	606	17.00	4,600
3.90	133	6.00	327	9.50	653	17.50	5,140
4.00	143	6.20	345	10.00	700		

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1903 and 1904. It is not well defined.

Estimated monthly discharge of Silvies River near Burns, Oreg., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	42	6	24.0	1,476
February	1,075	28	285	16,390
March	3,628	235	791	48,640
April	4,730	629	2,460	146,400
May	2,332	409	1,057	64,990
June	409	51	211	12,560
July	69	37	50.1	3,080
August	37	15	21.9	1,347
September	28	15	16.3	970
October	33	24	30.2	1,857
November	33	33	33.0	1,964
December	46	24	30.7	1,888
The year	4,730	6	418	301,600

SILVER CREEK NEAR RILEY, OREG.

This station was established April 19, 1904, by John H. Lewis. The gage is located at bridge No. 3, crossing the east or main channel of Silver Creek, on the Burns-Shaniko stage line, 12 miles above Riley, Oreg., and 6 miles below the proposed reservoir site on Silver Creek. A plain staff gage, graduated to feet and tenths, is attached vertically to timbers on the lower side of the bridge at the left bank. During 1904 the gage was read once each day by H. D. Cecil, Ben Mutter, and R. M. Cantrell. From April 19 to September 10, 1904, when the permanent gage was established, readings were obtained by measuring down to the water surface from a mark on the bridge floor with a rod so graduated as to give gage readings direct. Discharge measurements are made from three bridges over the three channels of the stream, in the line with the gage, and at high stages an additional slough is measured by wading. The initial point for soundings is the west end of the floor at each of the bridges. The channels are straight for about 80 feet above and 50 feet below the station, and the current is sluggish. Both banks are low, covered with sagebrush, and subject to overflow. The bed of the stream is composed of sandy clay, free from vegetation, and shifting. There are three channels at low water and four or more at extreme floods. The bench mark is a standard United States Geological Survey iron bench-mark post on the north side of the road in front of the house of the observer. Its elevation is 20.19 feet above the zero of the gage. The bench mark is 4,345 feet above sea level, datum H. The top of the floor of bridge No. 1 at the 21-foot mark is 4,339.87 feet above sea level, and 15.06 feet above the zero of the gage. The top of the floor of bridge No. 2 at the 20-foot mark is 4,338.69 feet above sea level, and 13.88 feet above the zero of the gage. The top of the floor of bridge No. 3 at the 30-foot mark is 4,339.81 feet above sea level and 15.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of John T. Whistler, district engineer.

Discharge measurements on Silver Creek near Riley, Oreg., in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
September 15					2.15	1.0
1904.						
April 16	J. H. Lewis		722	1.86	12.95	1,346
April 17	do		602	1.90	12.75	1,145
May 3	do	88	239	1.56	9.45	374
May 10	do	49	157	1.93	8.30	303
May 21	do	43	90	1.25	6.35	112
June 5	do	34	51	.84	5.30	43
June 15 [a]	M. L. Lewis	34	43	.77	5.00	33
June 25	W. C. Sawyer	26	26	.56	4.72	14
September 10 [b]	do	4	1.0	.75	4.37	.8
October 11	Landis and Cupper	5	6.7	.65	4.45	4.3
October 29	do	11	3.0	.97	4.40	3.0

[a] Measurement made from Bridge No. 3. [b] Measured by wading.

Mean daily gage height, in feet, of Silver Creek near Riley, Oreg., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.90	5.35	4.76	.....	.....	4.40	4.40	4.55
2	.....	9.80	5.30	4.75	.....	.....	4.40	4.40	4.55
3	.....	9.45	5.50	4.78	.....	.....	.....	4.40	4.55
4	.....	9.30	5.60	4.70	.....	.....	4.40	4.40	4.55
5	.....	9.00	6.70	5.20	.....	.....	4.40	4.40	.....
6	.....	8.75	6.50	6.20	.....	.....	4.40	4.40	4.55
7	.....	8.60	6.45	6.75	.....	.....	4.40	.....	4.55
8	.....	8.50	5.80	6.74	.....	.....	4.40	4.45	4.50
9	.....	8.35	5.31	6.78	.....	.....	4.40	4.50	4.55
10	.....	8.30	5.29	6.72	.....	4.37	.....	4.50	4.55
11	.....	8.05	5.32	6.71	.....	4.40	4.40	4.50	4.55
12	.....	7.80	5.25	6.50	.....	.....	4.40	4.50	.....
13	.....	7.60	5.20	6.30	.....	4.40	4.40	4.50	4.55
14	13.95	7.60	4.80	6.20	.....	4.40	4.40	.....	4.55
15	13.45	7.40	4.85	5.34	.....	4.40	4.40	4.55	4.55
16	12.95	7.35	4.85	5.20	.....	4.40	4.40	4.55	4.55
17	12.75	6.90	4.84	.....	.....	4.40	.....	4.55	4.55
18	12.55	6.45	4.82	.....	.....	4.40	4.45	4.55	4.55
19	12.45	6.50	4.80	.....	.....	.....	4.45	4.55	.....
20	12.30	6.35	4.76	.....	.....	4.40	4.45	4.55	4.55
21	11.90	6.30	4.75	.....	.....	4.40	4.40	.....	4.55
22	11.40	6.25	4.73	.....	.....	4.40	4.40	4.55	4.60
23	10.95	6.20	4.74	.....	.....	4.40	4.40	4.55	5.00
24	10.45	6.15	4.73	.....	.....	4.40	.....	4.55	5.00
25	10.05	6.10	4.72	.....	.....	4.40	4.40	4.55	5.00
26	10.75	6.20	4.71	.....	.....	.....	4.40	4.55	.....
27	10.90	6.25	4.70	.....	.....	4.45	4.40	4.55	5.00
28	11.10	6.30	4.71	.....	.....	4.45	4.40	.....	5.00
29	10.50	6.50	4.72	.....	.....	4.45	4.30	4.55	5.00
30	10.10	5.85	4.74	.....	.....	4.40	4.40	4.55	5.00
31	.....	5.50	.....	.....	.....	.....	.....	.....	5.00

Rating table for Silver Creek near Riley, Oreg., from April 14 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.30	0	5.80	78	7.30	184	9.60	424
4.40	2	5.90	84	7.40	192	9.80	452
4.50	6	6.00	90	7.50	200	10.00	480
4.60	10	6.10	96	7.60	208	10.20	512
4.70	14	6.20	102	7.70	216	10.40	544
4.80	18	6.30	108	7.80	225	10.60	578
4.90	24	6.40	114	7.90	235	10.80	614
5.00	30	6.50	120	8.00	245	11.00	650
5.10	36	6.60	128	8.20	265	11.50	758
5.20	42	6.70	136	8.40	285	12.00	890
5.30	48	6.80	144	8.60	305	12.50	1,061
5.40	54	6.90	152	8.80	326	13.00	1,290
5.50	60	7.00	160	9.00	350	13.50	1,540
5.60	66	7.10	168	9.20	374	14.00	1,790
5.70	72	7.20	176	9.40	398		

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1904. It is fairly defined between gage heights 4.40 feet and 13.00 feet.

Estimated monthly discharge of Silver Creek near Riley, Oreg., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	.....	.....	10.0	615
February	.....	.....	20.0	1,150
March	.....	.....	450	27,67[illegible]
April	.....	.....	935	55,64[illegible]
May	466	60	206	12,67[illegible]
June	136	14	38.7	2,3[illegible]
July	.....	.....	54.2	3,33[illegible]
August	.....	.....	5.8	35[illegible]
September	.....	.....	2.6	15[illegible]
October	4	2	2.3	14[illegible]
November	8	2	6.2	3[illegible]
December	30	6	14.4	[illegible]
The year	.....	.....	145	105,3[illegible]

NOTE.—Discharge estimated January 1 to April 14 and July 17 to September 9, inclusive. During latter part of year gage heights estimated for missing days.

MISCELLANEOUS MEASUREMENTS IN GREAT BASIN.

The following miscellaneous measurements were made in the Great Basin in 1904:

Measurements of ditches in Reno Valley in 1904.

Date.	Hydrographer.	Ditch.	Location.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
May 21	O. Heizer	Abby	Near head-gate	2.1	16
June 6	do	do	do	2.0	18
July 8	do	do	do	1.5	8.2
July 28	do	do	do	1.9	11
Aug. 9	do	do	do	1.9	10
Aug. 23	do	do	do	1.7	5.4
Aug. 23	do	Chism	do		2.7
June 20	do	do	do	2.2	3.1
June 24	do	do	do	2.3	3.8
May 21	do	Cochron	Near V. & T. culvert	2.8	36
June 2	do	do	do	2.7	32
June 29	do	do	do	2.5	24
Aug. 23	do	do	do	2.7	22
Aug. 23	do	Colombo	Near asylum		5.1
Aug. 23	do	do	do		4.7
July 7	do	do	do	2.3	3.1
July 27	do	do	do	2.4	3.9
Aug. 22	do	do	do	1.9	1.4
Aug. 22	do	Countryman	Near head-gate		2.6
June 20	do	do	do	2.6	2.1
June 28	do	do	do	3.0	3.9
June 28	do	English Mill	Chestnut street		18
June 21	do	do	do	1.7	19
July 7	do	do	do	1.3	12
July 20	do	do	do	1.8	18
Aug. 13	do	do	do	1.7	17
May 19	do	Frey or Indian	Flume near head-gate	1.4	23
May 31	do	do	do	1.4	17
June 20	do	do	do	1.0	12
July 12	do	do	do	.8	8.1
Aug. 3	do	do	do	1.0	11
Aug. 16	do	do	do	1.4	14
	do	Glendale	Near source		12
May 30	do	do	do	2.7	12
June 9	do	do	do	2.7	12
June 13	do	do	do	3.2	19

Measurements of ditches in Reno Valley in 1904—Continued.

Date.	Hydrographer.	Ditch.	Location.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
June 21	O. Heizer	Glendale	Near source	2.7	20
June 28	do	do	do	3.0	12
July 27	do	do	do	2.9	12
Aug. 3	do	do	do	3.0	19
June 10	do	Highland	West of cemetery	1.6	27
July 12	do	do	do	1.7	27
July 18	do	do	do	1.7	26
Aug. 11	do	do	do	1.8	25
May 30	do	Holcomb	Near Mayberry bridge	2.6	47
June 24	do	do	do	2.6	40
July 7	do	do	do	2.4	35
July 12	do	do	do	2.4	38
May 19	do	Lake	Near head-gate	2.4	39
May 31	do	do	do	2.3	38
July 12	do	do	do	2.2	33
Aug. 5	do	do	do	2.5	38
Aug. 15	do	do	do	2.7	41
June 22	do	Merrill	do	2.0	19
July 8	do	do	do	1.8	15
July 28	do	do	do	1.9	15
Aug. 4	do	do	do	1.6	12
Aug. 29	do	do	do	1.3	8.0
Aug. 29	do	Mitchell & Carmac	do		11
Aug. 29	do	do	do		18
May 30	do	do	do	2.6	17
June 17	do	do	do	2.6	13
July 9	do	do	do	3.2	16
Aug. 3	do	do	do	3.2	12
May 23	do	North Truckee irrigation.	Asylum road	2.2	37
May 30	do	do	do	2.0	38
June 10	do	do	do	2.1	37
June 20	do	do	do	1.6	23
Aug. 2	do	do	do	2.4	29
May 21	do	Orr	Flume near old seminary.	2.0	60
July 7	do	do	do	1.5	41
July 20	do	do	do	2.4	70
Aug. 10	do	do	do	2.2	64
May 21	do	Pioneer	Near head-gate	2.6	25
June 9	do	do	do	3.0	32

Measurements of ditches in Reno Valley in 1904—Continued.

Date.	Hydrographer.	Ditch.	Location.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
June 23..	O. Heizer....	Pioneer.....	Near headgate	3.2	45
July 7...	.....do	.....do	.....do	2.0	15
July 13..	.....do	.....do	.....do	2.0	15
July 25..	.....do	.....do	.....do	2.5	25
Aug. 5...	.....do	.....do	.....do	2.8	23
Aug. 8...	.....do	.....do	.....do	2.1	8.8
May 21..	.....do	Scott ranch	Near county hospital .	1.8	37
June 1...	.....do	... .do	.....do	1.6	34
June 15..	.....do	.....do	.....do	2.0	41
July 21..	.....do	.....do	.....do	1.6	28
Aug. 8...	.....do	.....do	.....do	1.7	30
Aug. 8...	.....do	Sessions	Near headgate	.....	3.6
June 2...	.....do	.....do	.....do	1.8	1.5
June 10..	.....do	.....do	.....do	2.2	4.4
June 20..	.....do	.....do	.....do	1.6	.6
Aug. 2...	.....do	.....do	.....do	2.2	2.4
June 16..	.....do	Steamboat.....	Above Wiley's, Verdi.	2.8	57
June 22..	.....do	.....do	.....do	2.8	59
July 8...	.....do	.....do	.....do	2.8	57
July 28..	.....do	.....do	.....do	2.8	56
Aug. 4...	.....do	.....do	.....do	2.8	56
Aug. 29..	.....do	.....do	.....do	2.8	56
Aug. 29..	.....do	Sullivan	Reno, Spark's road ...	.....	47
July 7...	.....do	.....do	.....do	2.2	26
Aug. 8...	.....do	.....do	.....do	2.6	38
May 31..	.....do	Wheeler.....	Near headgate	2.0	47
July 12..	.....do	.....do	.....do	1.9	42
Aug. 5...	.....do	.....do	.....do	2.1	43
Aug. 13..	.....do	.....do	.....do	2.3	43
June 1...	.....do	Wilson	Flume, near Glendale ditch.	2.2	3.4
June 6...	.....do	.....do	.....do	2.1	2.7
July 18..	.....do	.....do	.....do	2.3	3.6
Aug. 15..	.....do	.....do	.....do	2.4	3.7
June 2...	.....do	Mayberry & Carr ..	Near headgate	.....	1.6
July 28..	.....do	.....do	.....do	.....	2.1
Aug. 29..	.....do	.....do	.....do	.....	1.5
June 2...	.....do	Hunter Creek.....	Above diversions.....	.....	2.5
June 22..	.....do	.....do	.....do	.....	3.0
June 2...	.....do	Mayberry, north side.	Near headgate	.....	1.3

Measurements of ditches in Reno Valley in 1904—Continued.

Date.	Hydrographer.	Ditch.	Location.	Gage height.	Discharge.
					Sec.-ft.
June 16..	O. Heizer....	Hogan	Near headgate	.....	8.9
Aug. 29..	.....do	.....do	.....do	.....	5.7
July 28..	.....do	.....do	.....do	.....	9.4
July 8...	.....do	Katz	.....do	.....	9.5
July 28..	.....do	.....do	.....do	.....	11
Aug. 29..	.....do	.....do	.....do	.....	8.0

Miscellaneous stream measurements in Carson River basin, Nevada and California, in 1904.

Date.	Hydrographer.	Stream.	Location.	Discharge.
		CALIFORNIA.		Sec.-ft.
Aug. 31..	J. T. Shaw ...	Bruns	Mouth of canyon...	7.9
Aug. 31..	.....do	Fairview	.....do	4.6
		NEVADA.		
Aug. 31..	J. T. Shaw ...	Heitmans Springs	Mouth of canyon...	1.2
Aug. 31..	.....do	Garaveti No. 1	.....do	4.2
Aug. 31..	.....do	Garaveti No. 2	.....do	1.0
Aug. 31..	.....do	Monfrena Spring.....	.....do	1.2
Aug. 31..	.....do	Scossa Creek.....	.....do	2.3
Sept. 1...	.....do	Palmer Creek.....	.....do	3.1
Sept. 1...	.....do	Sheridan Creek	.....do	3.6
Sept. 1...	.....do	Parks Creek	.....do	3.4
Sept. 1...	.....do	Motts Creek	.....do	3.1
Sept. 1...	.....do	Kingsbury Creek.....	.....do	2.3
Sept. 1...	.....do	Genoa Creek.....	.....do	1.7
Sept. 1...	.....do	Sierra or Dressler	.....do	2.1
Sept. 1...	.....do	James Canyon	.....do	1.4
Sept. 1...	.....do	Jacks Valley.....	.....do	1.8
Sept. 1...	.....do	Clear Creek.....	.....do	1.2
Sept. 3...	.....do	Kings Canyon	.....do	5.4
Sept. 5...	.....do	Ash Canyon	.....do	1.1

Miscellaneous stream measurements in Antelope Valley in 1904.

Date.	Hydrographer.	Creek or ditch.	Location.	Discharge.
				Sec.-ft.
Sept. 8	J. T. Shaw	Little Antelope Creek	Mouth of canyon	2.1
Sept. 8	do	Lost and Mill Canyon	do	5.2
Sept. 9	do	Shields Creek	do	3.8
Sept. 9	do	Hardy ditch	Near Headgate	5.5
Sept. 9	do	Goodknow ditch	do	9.3
Sept. 9	do	Chichester ditch No. 1	do	4.9
Sept. 9	do	Coleville ditch	do	3.8
Sept. 9	do	Alkali ditch	do	3.3
Sept. 9	do	Swager ditch	do	24
Sept. 10	do	Salmon or Carney ditch	do	4.9
Sept. 10	do	Barnett and Love ditch	do	32
Sept. 10	do	Eggleston ditch	do	14
Sept. 10	do	Gullickson ditch	do	5.9
Sept. 10	do	West Walker ditch	do	33
Sept. 10	do	Eggleston ditch	do	10
Sept. 10	do	Goodknow and Harney ditch	do	1.0
Sept. 10	do	Terry ditch	do	9.6
Sept. 10	do	Taylor ditch	do	22
Sept. 11	do	West Walker River	Hoy's bridge	41

Miscellaneous measurements of creeks in Truckee River basin, Nevada, in 1904.

Date.	Hydrographer.	Creek.	Location.	Discharge.
				Sec.-feet.
Sept. 19	J. T. Shaw	Simmonds	Mouth of canyon	1.1
Sept. 19	do	Musgrove	do	1.9
Sept. 19	do	Lewers	Lewer's ranch	.3
Sept. 19	do	do	do	.1
Sept. 19	do	Browns	Mouth of canyon	2.1
Sept. 20	do	Franktown	do	3.5
Sept. 20	do	Ophir	do	6.0
Sept. 20	do	Steamboat	do	.6

Miscellaneous measurements in Utah Lake basin in 1904.

[By C. Tanner, W. G. Swendsen, and H. S. Kleinschmidt.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
			Feet.	*Sq. feet.*	*Ft. per second.*	*Feet.*	*Sec.-ft.*
Feb. 2	Peteetneet Creek	Payson	7	4.7	1.08	.....	5
Feb. 2	.....do	At rating flume	3.5	1.5	1.44	.....	2
May 17	.....do	In canyon	18	22	3.54	1.08	77
May 17	.....do	.....do	18	29	3.95	1.40	11[illegible]
Sept. 16	.....do	Payson	10	5.0	1.54	.....	8
Apr. 19	Payson slough	Near mouth	16	14	.93	.....	13
May 16	.....do	.....do	10	13	.61	.....	8
Dec. 22	.....do	.....do	12	7.6	.91	.....	7
July 26	Provo Bench canal	Below mouth of canyon	16	26	2.63	.....	6[illegible]
July 26	Tanner's race	Provo, Utah	8	6.0	2.50	.....	15
Sept. 17	Discharge of Salem pond.	Salem, Utah	.....	.....	.....	.....	2
May 26	Lake Shore canal	Lake Shore, Utah	10	32	2.34	.....	75
May 27	Mill race	Spanish Fork, Utah	13	29	3.69	.....	10[illegible]
May 27	Canal	.....do	7	9.0	2.79	.....	2[illegible]
May 27	Bench canal	Near mouth of canyon	7	24	4.37	.....	10[illegible]
May 27	Salem canal	.....do	12	21	1.64	.....	34
May 27	New Survey canal	.....do	8	19	3.19	.....	5[illegible]
May 27	Mill race waste	Below Spanish Fork City.	13	13	1.77	.....	2[illegible]
Sept. 16	Spring Lake	Spring Lake, Utah	5	2.8	.61	.....	[illegible]
July 26	West Union canal	Near Provo, Utah	12	11	3.39	.85	3[illegible]
Apr. 3	Daniels Creek	Daniels canyon	.....	.....	.....	.....	[illegible]
May 17	Santaquin Creek	Santaquin, Utah	11	15	4.69	.....	7[illegible]
Sept. 16	.....do	.....do	10	5.6	1.71	.....	10
Dec. 20	Provo River	Above Telluride Power Co.'s intake dam.	63	128	1.93	.....	24[illegible]
Jan. 19 to Jan. 23	Utah Lake seepage[a]	41 streams	.....	.....	.....	.....	26[illegible]
May 14 to May 15	.....do	44 streams	.....	.....	.....	.....	32[illegible]
May 31	.....do	25 streams	.....	.....	.....	.....	9[illegible]
June 18 to June 23	.....do	26 streams	.....	.....	.....	.....	17[illegible]
Aug. 1 to Aug. 2	.....do	25 streams	.....	.....	.....	.....	15[illegible]
Oct. 15	.....do	.....do	.....	.....	.....	.....	17[illegible]
Dec. 3 to Dec. 5	.....do	.....do	.....	.....	.....	.....	17[illegible]

[a] This includes all measured inflow excepting Provo River and Spanish Fork River.

Estimated monthly discharge of all measured streams flowing into Utah Lake near shore of lake, Utah, for 1904.

Month.	Total in acre-feet.	Month.	Total in acre-feet.
January	24,470	August	8,141
February	32,770	September	9,174
March	37,820	October	12,300
April	48,470	November	15,230
May	88,160	December	21,490
June	52,490	The year	359,200
July	8,718		

NOTE.—The above table includes all measurable streams of any character flowing into Utah Lake.

Miscellaneous measurements in Bear River basin in 1904.

[By C. Tanner, W. G. Swendsen, and H. S. Kleinschmidt.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per second.*	*Feet.*	*Sec.-feet.*
Nov. 7	North Branch of St. Charles Creek.	One-fourth mile east of road.	16	8.8	1.59	.....	14
May 6	Fish Haven Creek No. 5.	Fishhaven, Idaho	9	10	2.72	.....	27
June 10	.....do	.....do	9	15	2.77	.....	41
Nov. 8	.....do	.....do	12	5.2	1.23	.....	6
Dec. 21	.....do	.....do	12	7.1	1.37	.....	10
May 6	Swan Creek No. 6	3 miles south of Fishhaven on county road.	13	32	3.93	.....	126
June 10	.....do	.....do	13	38	4.63	.....	178
June 29	.....do	.....do	13	34	2.48	.....	84
Nov. 8	.....do	At lake	25	24	1.82	.....	43
Dec. 21	.....do	On county road	18	30	1.44	.....	44
May 6	Laketown Creek (weir) Nos. 7–9.	Near Laketown	16	.....	.....	.....	50
Nov. 8	Spring Creek	Laketown, Idaho	10	11	.96	.....	10
May 7	North Eden Creek No. 11.	North Eden, Idaho	4.5	3.8	1.90	.....	7
May 8	Stephen's slough	Dingle, Idaho	15	60	2.76	.....	166
July 7	Power canal left side Bear River.	Bear River Canyon	21	84	1.87	.....	157
June 4	Logan and Hyde Park canal.	Logan, Utah	10	19	3.72	5.1	72
July 3	.....do	.....do	10	23	3.24	5.5	74
Dec. 17	.....do	.....do	9.0	14	.72	.....	10
Nov. 7	Bear Lake outlet, flowing into Bear Lake this date.	Bridge on turnpike	38	152	.26	.....	40
May 5	Ovid Creek No. 1	Ovid, Idaho	65	185	1.95	.....	362
June 9	.....do	.....do	58	73	2.13	.....	157
June 28	.....do	.....do	12	39	.61	.....	24
Dec. 21	.....do	.....do	10	9.0	1.16	.....	10
May 5	Paris Creek No. 2	Paris, Idaho	25	23	2.42	.....	55
June 10	.....do	.....do	28	41	2.55	.....	106
June 30	.....do	.....do	20	20	1.12	.....	23

Miscellaneous measurements in Bear River basin in 1904—Continued.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge
			Feet.	*Sq. feet.*	*Ft. per second.*	*Sec.-ft.*
Nov. 8	Paris Creek No. 2	Paris, Idaho	25	18	.96	
Dec. 21	.....do	.....do	42	24	1.24	
May 5	Bloomington Creek No. 3	Bloomington, Idaho	22	22	2.50	
June 10	.....do	.....do	12	17	2.79	
June 28	.....do	.....do	30	24	2.16	
Nov. 8	.....do	.....do	16	14	2.31	
Dec. 21	.....do	.....do	18	12	1.74	
May 5	.....	3 creeks between Bloomington and St. Charles.	.....	.....	.....	
May 5	St. Charles Creek No. 4	St. Charles, Idaho	41	62	2.31	
June 10	.....do	.....do	43	66	3.35	
June 29	.....do	.....do	44	62	1.77	
Nov. 8	.....do	.....do	18	9.6	1.77	
Dec. 21	.....do	.....do	22	21	1.33	

Miscellaneous measurements in Jordan River basin in 1904.

[By Caleb Tanner.]

Date.	Stream.	Locality.	Width.	Area of section	Mean velocity.	Discharge
			Feet.	*Sq. feet.*	*Ft. per second.*	*Sec.-ft.*
Dec. 7	Jordan River	Hub dairy, Salt Lake City, Utah.	54	125	1.53	
Dec. 7	.....do	Above Little Cottonwood Creek.	40	51	1.21	
Dec. 7	.....do	Near sewer farm	103	203	1.05	
Dec. 6	Big Cottonwood Creek	One-fourth mile above mouth.	26	28	1.83	
Dec. 6	Decker Lake outlet	At Redwood road crossing.	5.5	3.6	.82	
Dec. 7	Hot Spring Lake outlet	North of Salt Lake City, Utah.	17	8.2	.93	
Dec. 6	Little Cottonwood Creek	Near mouth	12	6.9	1.18	
Dec. 6	Mill Creek	.....do	8.5	9.1	2.62	
Dec. 6	North Branch of Parleys Creek	.....do	6.0	3.0	.86	
Dec. 6	South Branch of Parleys Creek	.....do	8.0	4.3	1.44	
Dec. 6	Taylorsville roller mill flume	Opposite Little Cottonwood Creek.	6.8	23	1.70	

Miscellaneous measurements in Duchesne River basin in 1904.

[By C. Tanner and F. Thomas.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per second.*	*Sec.-feet.*
Oct. 6	Spring Branch	Tributary from left North Fork Duchesne, just above gaging station.	11	8.4	1.25	10
Oct. 6	.....do	Tributary North Fork Duchesne from right, just above cable station.	.....	.....	.....	9.0
Oct. 7	Hades Creek	Tributary North Fork Duchesne.	6	4.3	1.43	6.2
Oct. 7	Mountain stream	Tributary North Fork Duchesne, 1 mile below Hades Creek.	.....	.....	.....	1.5
Oct. 7	North Fork Duchesne	Reconnaissance survey crossing.	33	30	.80	24
Oct. 8	West Fork Duchesne	.....do	14	12	1.17	14
Oct. 8	Nos. 1, 2, 3, and 4	Tributaries West Fork Duchesne, between reconnaissance survey crossing and cable station.	.....	.....	.....	3
Oct. 12	Mud Creek	At upper contour, State reservoir survey, Strawberry Valley.	3	.8	.82	.6
Oct. 12	Strawberry River	.....do	16	9.7	.98	9.7
Oct. 12	Spring Branch	.....do	(a)	(a)	(a)	.2
Oct. 12	.....do	.....do	.8	.28	1.00	.3
Oct. 12	Trout Creek	.....do	2.0	1.6	1.19	3.4
Oct. 12	Springs	At upper contour, State reservoir survey, Strawberry Valley, between Trout Creek and Coal Canyon.	.....	.....	.....	a.5
Oct. 12	Bryants Fork	At upper contour, State reservoir survey, Strawberry Valley.	5.5	4.7	.64	3.0
Oct. 12	Indian Creek	.....do	9	5.9	2.25	13
May 26	Wolf Creek	Tributary West Fork Duchesne.	12	9.5	3.35	32
June 16	.....do	.....do	12	9.4	2.66	25
June 26	.....do	.....do	11	8.0	2.33	19
July 18	.....do	.....do	10	6.1	1.86	12
Aug. 16	.....do	.....do	10	5.2	2.10	11
Oct. 8	.....do	.....do	9.5	4.9	1.56	8
Apr. 5	Duchesne River	Twelve miles below forks.	60	66	1.28	85
Apr. 5	Red Creek	Four miles above junction of Currant and Red creeks.	10	5	1.25	6
Apr. 6	West Fork Duchesne	At forks	18	21	1.02	21
Apr. 6	North Fork Duchesne	.....do	32	33	1.39	46
Apr. 7	Rock Creek	At junction with Duchesne River.	36	42	1.10	46
Apr. 8	Lake Fork	Eight miles above junction with Duchesne.	34	43	1.77	77
Apr. 9	Strawberry River	At Starvation	46	44	2.37	104
Apr. 9	.....do	Above Red Creek	32	37	1.45	54
Sept. 2	East Fork of Lake Fork	Eight miles above forks of Lake Fork.	41	52	2.26	118

a Estimated.

Miscellaneous measurements in Duchesne River basin in 1904—Continued.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per second.*	*Sec.-feet.*
Sept. 24	Water Hollow	Tributary Currant Creek.	5.5	2.5	1.34	3.4
Sept. 24	Little Red Creek	....do	3	1.2	1.10	1.3
Sept. 24	....do	Currant Creek (from right, 5¼ miles above gaging station at road crossing).	3.5	1.2	1.50	1.8
Sept. 29	Creek Nos. 1-2	Tributary West Fork of Lake Fork.				a.3
Oct. 4	Rock Creek	At Reconnaissance Survey crossing.		22	1.39	31
Oct. 4	Big Spring	Tributary Rock Creek one-eighth mile below Reconnaissance Survey crossing.	7	4.2	1.75	7.4
Oct. 4	Nos. 1-8	Tributary Rock Creek between big spring and cable station.				a2.1
Oct. 4	Tawanta Creek	Tributary Rock Creek one-eighth mile below gaging station.				a.7

a Estimated.

Miscellaneous measurements in Weber and Malad River basins in 1904.

[By W. D. Beers.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per sec.*	*Sec.-feet.*
Dec. 14	Lost Creek	Near Croydon, Utah	17	10	0.81	8
Dec. 14	....do	Near junction with Weber River.	29	28	.94	26
Dec. 14	Weber River	At Devils Slide	90	96	1.77	170
Dec. 15	....do	Devils Gate	90	107	2.07	222
May 11	Malad River	At Riverside, Utah	23	52	1.06	55

Miscellaneous measurements in Sevier River basin in 1904.

[By C. Tanner.]

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-f*
Mar. 4	Sevier River	Sevier Bridge, Utah	49	78	0.99	0.91	7
Mar. 21	....do	....do	20	20	2.40	.55	4
Aug. 20	....do	....do	20	22	2.10	.....	4
Oct. 26	....do	....do	20	23	2.26	.....	5

Miscellaneous measurements in Willow Creek basin, California, in 1904.

Date.	Hydrographer.	Stream.	Locality.	Discharge.
1904.				*Second-feet.*
January 7	J. S. Evans	Willow Creek.	Susanville	11.6
May 12	James Branham	do	do	9
August 16	S. G. Bennett and J. Y. Toler.	do	do	5.4
November 11	James Branham	do	Standish	52

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O

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
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1893 Bulletin No. 131.
1894. Bulletin No. 131: Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11: Eighteenth Annual Report, Part IV.
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1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
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1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
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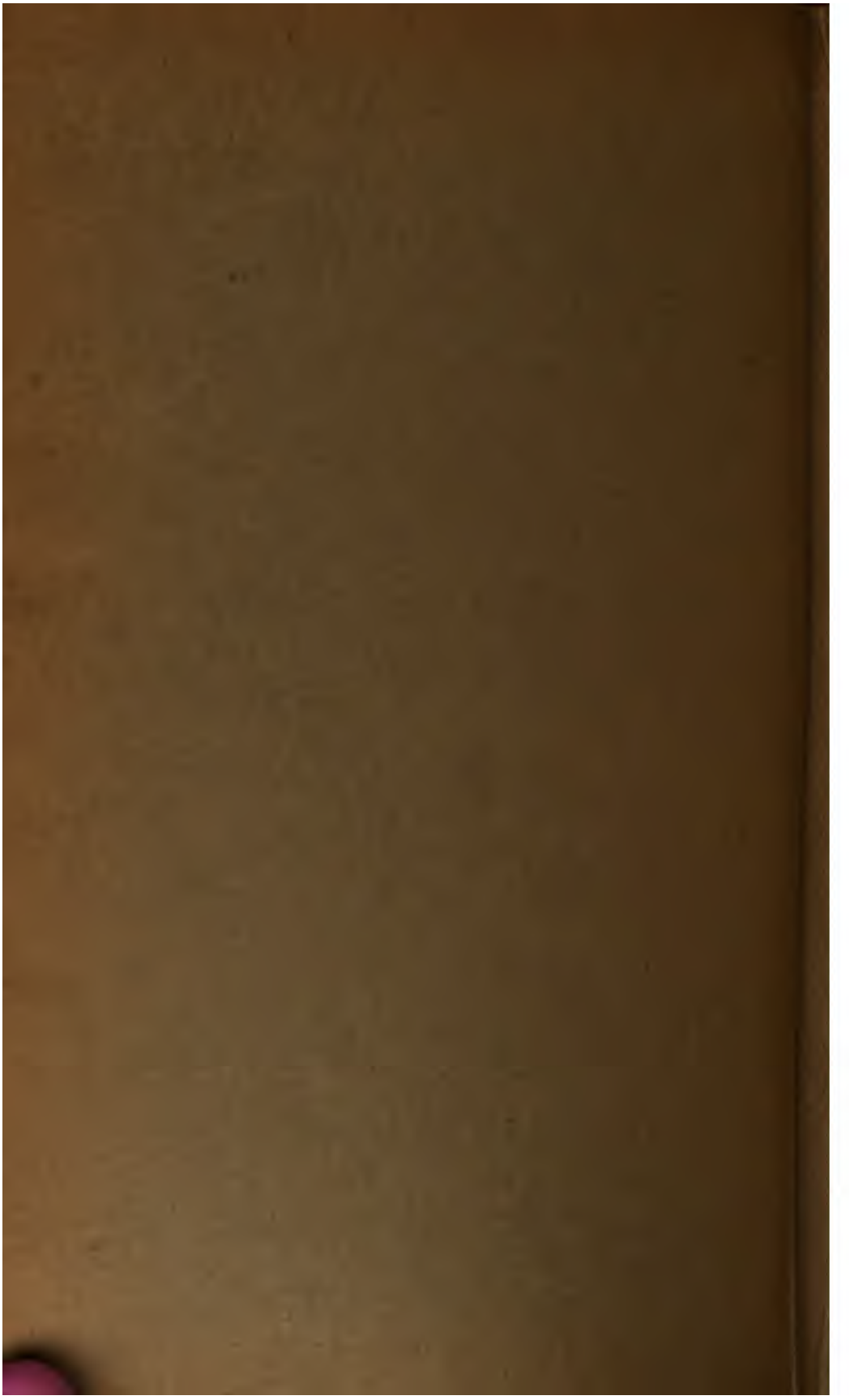

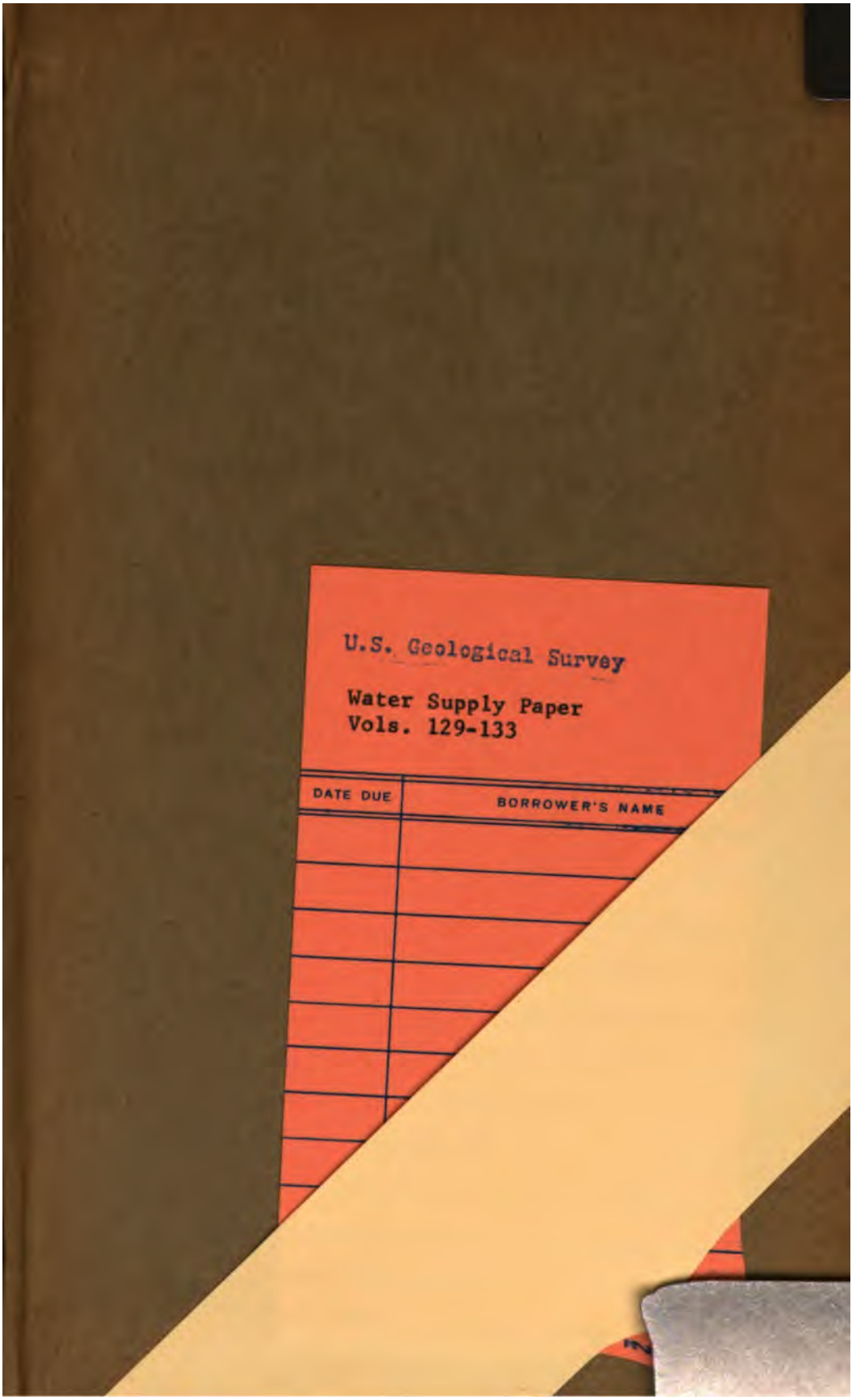
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